MANUAL FOR
HIGH TECH FLORICULTURE

CENTRE FOR TESTING AND TRAINING FOR PROVIDING TECHNICAL BACKUP TO THE BENEFICIARIES FOR AGRICULTURAL AND HORTICULTURAL DEVELOPMENT

INSTITUTE OF AGRICULTURAL SCIENCE
UNIVERSITY OF CALCUTTA

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MANUAL
FOR
HIGH TECH FLORICULTURE

38

Edited By
Prof. Ashim Chowdhury

CENTRE FOR TESTING AND TRAINING FOR PROVIDING TECHNICAL BACKUP TO THE BENEFICIARIES FOR AGRICULTURAL AND HORTICULTURAL DEVELOPMENT

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No. ....

Date : September 19, 2011

FOREWORD

It gives me immense pleasure to introduce the 'Technical Manual for High Tech. Floriculture' edited by Prof. Ashim Chowdhury, which is being published by the Calcutta University. This volume is a compilation of lectures delivered in a seminar on "High Tech. Floriculture for the Growers and Entrepreneurs" that was held on 13th and 14th February, 2007. The articles deal with issues concerning the development of Horticulture in West Bengal and Tripura. Apart from academics, farmers and technical officers from West Bengal and Tripura were present in the Training Programme.

I take this opportunity of putting on record the University's deep appreciation for the initiatives of Prof. Ashim Chowdhury for organizing the seminar and publishing the volume, which should evoke considerable interact among the reading public.

Suranjan Das.

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Dr. R. K. Samanta
Vice-Chancellor

Date :

It is indeed a great pleasure for me to note that a training programme was successfully organized by the Syndicate approved "Center for Testing & Training....... Development", Institute of Agricultural Science, University of Calcutta on "High Tech Floriculture for the Growers & Entrepreneurs", on 13th-14th February, 2007 in Collaboration with Food Processing Industries & Horticulture, Govt of West Bengal, BCKV (SAU), Deptt of Agriculture, Govt of Tripura & Samadarshi, NGO. Dignitaries like; Sri Mohanta Chatterjee, Hon'ble MIC, FPI & H Deptt, Govt of West Bengal, Sri Sudghangshu Seal, Hon'ble MP, Mr Faiyaz Ahmed Khan, MMIC, KMC, Sri Samir Chakrabarty, Hon'ble MIC of Agriculture, Govt of Tripura, Prof. P.K. Chattopadhaya, Former Dean, F/Hort, BCKV and Prof. R.K Sarkar, Former Dean, F/Ag, CU graced the occasion by their presence &. Prof. T.K. Mukherjee, Pro-VC, B A&F, University of Calcutta presided over the function.

Resources persons on various important topics from different Universities, Research Institutes delivered their lectures to the participants from all over the state & also from this manual is proposed to be published would be a compilation of the lectures delivered by the recourse persons .In my opinion this type of technical training manual will be of great help for the participants from West Bengal & Tripura & they will in turn the transfer the technical information to the lower level beneficiaries in respect of various problems of commercial floriculture. I appreciate the initiative taken by the "Center for Testing & Training Development", Institute of Agricultural Science, University of Calcutta under the leadership of Prof. Ashim Chowdhury, In-Charge, for holding such training program & wish to continue this effort on various other topics in collaboration with BCKV.

Dr. Ranajit Samanta
Vice-Chancellor
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আবু হেনা
ভারপ্রাপ্ত মন্ত্রী
মৎস্য, খাদ্য প্রক্রিয়াকরণ শিল্প ও উদ্যানপালন বিভাগ
পশ্চিমবঙ্গ সরকার

ABU HENA
Minister-in-Charge
Fisheries, Food Processing Industries
& Horticulture Departments
Govt. of West Bengal

MESSAGE

I am glad to know that a manual for High Tech Floriculture is going to be published by the Institute of Agricultural Science, University of Calcutta. This manual is a compilation of the lectures by the resource persons from different Universities, Research Institutes delivered during the training programe on ffigh Tech Floriculture for the growers & entrepreneurs", 13th-14th February, 2007 which was organized by the Syndicate approved "Center for Testing & Training for providing Technical back up to the beneficiaries of Agriculture & Horticulture Development", Institute of Agricultural Science, University of Calcutta, in collaboration with FPI & H Department, Govt. of West Bengal and Samadarshi (NGO) on various issues of High-Tech Floriculture.

Since commercial scale floriculture is going to be an income generating sectors for the growers & entrepreneurs in West Bengal & Tripura, the endeavour of holding Training Programme followed by publication of Technical Manual on various important issues of floriculture would be of a great help for them.

I convey my heartiest thanks to the organizers of this determined effort.

24/04/[illegible]

(Abu Hena)

Prof.(Dr.) Ashim Chowdhury,
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Calcutta University.

FOREWORD

The "Centre for Testing and Training for providing Technical Back-up to Beneficiaries for Agricultural and Horticultural Development" has ushered in a new era in developing the knowledge base of farmers, NGOs, Entrepreneurs, Industries and many other Government officials. I understand that the Centre addresses several important issues like production and preservation of quality seeds, fertility management, crop protection and bio-rational pest management and post harvest preservation and processing.

I believe publication of this Manual would also benefit all concerned at the grass-root level and the same will remain an extremely valuable document for High Tech Floriculture for the growers and entrepreneurs.

I hope the Centre will flourish under the able leadership of Prof. Ashim Chowdhury in the days to come.

Tapan Kumar Mukherjee

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Message

It is great pleasure for me that a manual for High Tech Floriculture is going to be published by the University of Calcutta Syndicate approved "Center for Testing & Training for providing Technical back up to the beneficiaries of Agriculture & Horticulture Development", Institute of Agricultural Science, F/Ag. This manual is compilation of the lectures by the resource persons from different Universities, Research Institutes delivered during the training programme on "High Tech Floriculture for the growers & entrepreneurs", 13th-14th February, 2007 organized by the Syndicate approved "Center for Testing & Training Development", Institute of Agricultural Science, University of Calcutta, in collaboration with FPI & H Department, Govt. of West Bengal and Samadarshi (NGO) on various issues of High-Tech Floriculture for the benefits of officers and lower level beneficiaries for the development of Horticulture in West Bengal & Tripura.

Since commercial scale floriculture is going to be an income generating sectors for the growers & entrepreneurs in West Bengal & Tripura, the endeavor of holding Training Programme followed by publication of Technical Manual on various important issues of floriculture would be of great help for them. I wish that this type of training programme on floriculture & various other important issues on Horticulture would be organized by the Center, University of Calcutta in future.

(Prof. A.K Dolui)

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From the Desk of the Editor

I am very glad to introduce the Manual on Floriculture compiling and editing the Lectures of the Resource persons from different Universities, Research Institutes delivered during the Training programme on various issues of High-Tech Floriculture for the benefits of officers and lower level beneficiaries for the Development of Horticulture in West Bengal & Tripura. The Training programme was organized by the Syndicate approved "Center for Testing & Training...Development", Institute of Agricultural Science, University of Calcutta on "High Tech Floriculture for the growers & entrepreneurs", 13th -14th February, 2007 in presence of dignitaries viz; Sri Mohanta Chatterjee, Hon'ble MIC, FPI & H Deptt, Govt. of West Bengal, Sri Sudghangshu Seal, Hon'ble MP, Mr Faiyaz Mohammad Khan, MIC KMC, Sri Tapan Chakrabarty, Hon'ble MIC of Agriculture, Govt. of Tripura and Prof. A.K. Dolui, Dean & Director & Prof. R. K. Sarkar, Former Dean & Director, F/Ag, Institute of Agricultural Science University of Calcutta, was all present to grace the occasion. Prof. T.K. Mukherjee, Pro-VC, BA & F, University of Calcutta, presided over the Inaugural function. About 50 participant form West Bengal & Tripura were participated in this training programme.

Resources persons on various important topics from different Universities. Research Institutes delivered their lectures to the participants from all over the state & also from this University. The manual is consisting of technical matter on floriculture development in West Bengal viz; Status, Growing of floricultural crops, Fertilizer management Weed management, Insect & disease management, protected cultivation and Orchid development.

In my opinion this type of technical training manual will be of great help for the participants from West Bengal & Tripura & they will in turn transfer the technical information to the lower level beneficiaries in respect of various problems of commercial floriculture. The "Center for Testing & Training.......Development", Institute of Agricultural Science, University of Calcutta wish to continue this effort on various other topics in collaboration with other organizations under the leadership of In-charge, Institute of Agricultural Science.

(Ashim Chowdhury)
Editor & In-charge
Center for Testing & Training...Agri/Horti Development

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AN OVERVIEW ON FLORICULTURE IN WEST BENGAL

P. K. Chattopadhyay

Preamble :

West Bengal is blessed with different agro-climates ranging from high mountains down to sea through a vast tract of fertile land. Due to existence of varied soil and climatic condition the state is able to grow wide range of flowering and ornamental plants. This state has to accommodate over 8 crores or 7.8% of country's population on only 2.8% of land indicating mostly dense state with population density of 904 numbers per square kilometer.

The available area for cultivation is 65% and 95% of the cultivated area is under crop production and only 5% remain as fallow and waste land. The net cultivated area of 55.2 lakh ha is shared by 58.5 lakh farmers indicating average holding size of only 0.85 ha. Thus it is clear that the agrarian sector is dominated by small and marginal farmers. The traditional agricultural crops are being replaced with horticultural crops very fast in the state.

Status :

In West Bengal flowers grown are chrysanthemum, rose, orchids, gladiolus, gerbera, anthurium, tuberose, lily, lotus, marigold, hibiscus, clitoria, balsam, jasmine, cocks comb and many other flowers. Ornamental plants are grown in the garden for landscaping and as house plants in nurseries almost throughout the state and there is dominance of the district south 24-Parganas. About 5000 nurseries cultivate ornamental plants both for domestic and international markets. Nursery business with ornamental plants has been increased manifold due to demand of pot plants for interior and exterior decorations in particulars.

Flower growers of the state sale cut flowers to maintain their livelihood. Marketing of cut flowers is still disorganized. The scenario is however changing with few floral boutiques that offer value added services.

Dried flowers and foliage have a special significance. They are used commercially as value added floral crafts. West Bengal accounts for 70% of dried flower exports although the state is not the major producer.

The flower seed production is a potential sector. But the state is still dependant on other states. Greenhouse cultivation is the recent approach to grow quality plants and flowers. Unfortunately greenhouse cultivated of flowers, foliage and other types of ornamental plants in West Bengal is insignificant.

The area under flower cultivation is about 17350 ha comprising the districts of Darjeeling (1156 ha), North Dinajpur, Malda, Murshidabad, Nadia

(5100 ha), North 24-Parganas (965 ha), South 24-Parganas, Howrah, Hooghly, Burdwan, Birbhum, West Medinipur (2224 ha) and East Medinipur (5114 ha). West Bengal produces 44,674 tonnes of loose flowers and 89,637 crore spikes.

The major flower production centres are Kalimpong, Panskura, Ranaghat, Thakurnagar and Bagnan. The auction market situated mainly in Mullick Ghat (Kolkata), Dhantala (Nadia), Thakurnagar (North 24-Parganas), New Market (Kolkata) and Deulia (East Medinipur).

Some initiatives have been taken for export of flowers from the state in Middle East (Sharjah), Holland (Aalsmeer, Flora Holland, Rijnsburg) and London. The export items are tuberose, gladiolus, rose, gerbera, carnation, cocks comb and aster.

More than 50,000 flower growers are engaged in commercial flower growing and ornamental plant production. A few lakh workers are engaged in trading of these floriculture products. West Bengal is supplying flowers, foliage and pot plants to different domestic markets in India.

Prospect :

Agro-climatic advantages of the state need to be exploited usefully for the commercial cultivation of flowers. The area and production of various flowers are possible to be augmented. Commercial cultivation of flowers for domestic market is a practice already prevailing in the state but its proper market and export have been undertaken recently.

Orchids are the natural home in the hills of Darjeeling specially in Kalimpong. Commercial production is available with *Cattleya* sp., *Phiaus maculates, Lone scariosa*, etc. Orchids are expensive bloom and are one of the most popular cut flowers on the market. Tropical orchids can be grown in the plains of West Bengal.

In West Bengal marigolds are mainly grown in East and West Medinipur, Nadia, North 24-Parganas and Howrah. The varieties are Apricot, Sungiant, Marietta, Star of India, etc. Marigolds are most important of all loose flowers and are in demand in the neighbouring states of West Bengal also.

Gladioli is grown throughut the state but is concentrated in Kalimpong and South Bengal in particular. The varieties like Suchitra, Sova, Sapna, Poonam, Mukta, Mohini, Manisha, Apsara, Melody, Agnirekha, American Beauty, Tropic Sea, Oscar, Sylvia, Wings Glory, Apollo, etc.

Anthuriums are in great demand in the international market due to its brilliant colours and long shelf life. It is mainly grown in Darjeeling and Jalpaiguri districts. It is a shade loving plant. Protected cultivation in South Bengal is promising.

A warm and humid climate is ideal for growing tuberose. It is cultivated commercially in the districts of East and West Medinipur, Howrah, North 24-Pargana, Nadia. Two important types—Single and double—Single is more popular and varieties are Shrinagar, Coimbatore, Bombay and Calcutta. Double type is also gaining commercial status—the varieties are—Swarnarekha and Subhasini.

Rose is one of the most important commercial flowers of the state and roses are grown throughout the state. Pruning is an essential operation in the management for quality bloom. Principal varieties are Montejuma, Fiole de France, Edward, Christian Dior, etc. Roses are in demand as cut flowers both for domestic and international market.

The second popular cut flower the world over is carnation which is available in various colours. The commercial cultivation is restricted to Kalimpong and Mirik. Recently its cultivation under cover has been undertaken mainly in South Bengal around Kolkata.

Gerbera has established as one of the most popular decorative garden plant or cut flower. Colours include white, yellow, orange, red, pink. It has a demand as cut flower both in domestic and international market. The cultivation is mostly concentrated in Darjeeling, Jalpaiguri, North and South 24-Parganas, Nadia, Hooghly and Burdwan.

In West Bengal lily is a major ornamental flower with varieties like Tiger lily, Water lily. Flowers are hardy. As such has a demand as cut flower. Lotus is also a commercial flower of the state.

Cut, dried and ornamental flowers are gaining commercial status. Rose is important in garlands, as cut flower and also for extraction of essential oil. Gladiolus is another important cut flower. Tube roses are sold loose for garlands and wreaths apart from use as spike. Orchids are placed as the premium cut flower item. Flower for the masses is marigold which is available throughout the year particularly the variety Siracole. Jasmines are also very popular and availability is in abundance particularly during summer months for garlands. The chrysanthemum has become very common and popular flower during winter months. This flower has a pride place in the state for both commercial and amateur growers. Aster, Golden rods are also important as cut flowers. Dried flower and foliage have a significant role with the flower lovers. These are value added floral crafts. Ornamental plants are grown for both home garden and interior decoration (indoor plant). Organized cultivation of indoor plants has a very bright commercial prospect.

The commercial cultivation should be targeted one. It should either be export oriented or solely for domestic market. Oil extraction from rose, jasmines etc is possible and need to be explored. Quality has become the key word and quality assurance is a must for any product. The flower growers are therefore must be very conscious about the production of quality flowers. The research and development effort on floriculture need to be strengthened and farmers are to be apprised for the use of balanced fertilizer through INM, optimum use of irrigation water and plant protection through integrated approach.

Constraints :

Availability of land is one of the major constraints for the development of floriculture in the state. Quality production of flower is yet to be ensured. Suitable packages of practices for area specific cultivation which shall include identified variety/varieties with types on irrigation, nutritional management, plant protection measures, post harvest handling etc are extremely lacking. Non-availability of quality planting material is a major hindrance for the development of floriculture in the state.

Infrastructures for various floricultural activities are inadequate. Research activities need to be strengthened to solve some major problems of floricultural crops. Poor linkage with the organizations engaged in research and development is a setback for the cause of improvement in the floriculture scenario. Week data base seems to be one of the primary constraint for development of floricultural crops.

Future Needs :

The data base on floriculture need to be strengthened for the development of a comprehensive strategy. Assured supply of better planting materials is a must. Commercial floriculture in Bankura, Purulia, Birbhum, Dakshin Dinajpur and Coochbehar need to be initiated. Drip irrigation system should be introduced wherever possible. Computer networking between production centre and flower markets is the need of the day. Farm level value addition and post harvest handling of flowers need serious attention.

Flower Growers' Association need to be formed immediately. High-tech floriculture for export should be encouraged. Cool chain system should be installed from the production site to the destination. Existing available markets need to be modernized with internet facilities. Packaging, storage and grading facilities need to be improved. Flower seed production is an area need immediate intervention. Improvement in the quality and quantity in terms of production of planting materials of ornamental plants need to be strengthened. Marketing of the produce should be assured. The extensive network of rail, road and waterways and also air network should be utilized in more organized manner.

A concerted approach of all the agencies related to floricultural activities will surely help in achieving proper development of floriculture in the State of West Bengal.

HIGH-TECH PRODUCTION OF FLOWERS

N. Roychowdhury

Floriculture Significance and Potential :

The world trade in cut flowers exceeds 56 billion of which India's share is just 0.1%. There is a booming market for this product in West Europe, and some parts of India are ideally placed to cater to this market. October to February is a lean season for flower production in Europe (because of the snowfall) while this period is perfectly suitable for production in India. With proper investments in the sector, India has the potential to capture a huge share of the world market.

West Bengal is well placed to exploit this opportunity because its agro climatic condition and abundant water supply is ideally suited for floriculture activities, offering a natural advantage for the commercialization of flora, especially in North Bengal & also in South Bengal. Further, airports at Bagdogra and Kolkata are strategically located in the northern and southern parts of the state respectively, providing the vital transport link—a crucial requirement for this sector.

Because of these factors, the sector has the potential to be viable if necessary investment is made in the cultivation (greenhouses, irrigation system etc.) and cold chain infrastructure.

Historically speaking, Darjeeling hills of North Bengal have played a pioneering role in the development of floriculture in India. In fact, nurseries at Kalimpong, in Darjeeling, were among the first to export floriculture products from India to USA, UK and other European countries.

With over 40 nurseries and 50% farmers engaged in floriculture, Kalimpong is the leading exporter of such products in Eastern India. In spite of inadequate infrastructure, exports worth Rs. 21 million (USD 0.46 million) takes space from small nurseries here. Cut flowers like Gladioli, Anthurium, Cymbidium, Gerbera are sold mainly in the domestic market, while planting material for these flowers are sold both in the domestic market and are exported to countries like Holland, Japan, Germany, Thailand, Italy etc.

Cut flower cultivation is also actively done in South Bengal. However, the species of flowers grown are not of exportable variety and are consumed mainly in the local market.

The main activity pertaining to floriculture in South Bengal is restricted to dry flower processing. Most of the dry flower processing is done in and around Kolkata—the capital city, with Kolkata Port accounting for about 70% of India's export. From here, over 500 varieties of dry flowers and pot-poultries are exported mainly to Western Europe. The growth of agro processing industry is intimately linked to the availability of required raw materials.

To ensure availability of quality produce at optimum prices, the concept of contract farming may be adopted. Contract farming supplemented by production from captive farms is the only possible solution to enable industry to be independent of raw material sourcing uncertainties.

The present cold storage capacity of 4.5 million tones in the state is mainly meant for the preservation of potatoes. What the state needs today is multi chamber cold storages with separate temperature and humidity control devices for fruits, flowers, vegetables etc. It is recommended that the government should not fix tariff for any stored item and that market forces should be allowed to determine storage charges.

Expenditure on research and development must be increased at least ten folds to keep up with developments elsewhere. Collaboration for production of several high value floriculture/horticulture crops through establishing of Export Oriented Horticultural Estate, and integrated floriculture parks Area likely to go a long way in improving production levels, both qualitatively and quantitatively. There is a definite need for improvement in product standardization and packaging. To ensure remunerative prices for the farmers it is recommended that the state government take the initiative to establish "regulated markets" close to production centers and equip them with cool house facility for temporary storage. It is widely acknowledged that there is a vast untapped potential in the state in the agro-horticulture sector, which can be used effectively to achieve speedy growth in the economy. Therefore there is a need to formulate a specific agro-horticulture-food processing policy to ensure that farmers get a better return and new job opportunities are created.

The objective of this policy to ensure that farmers get a better return and new job opportunities are created. The objective of this policy should be to eliminate or minimize wastage of agriculture and horticulture produces, facilitate production of value added processed food that not only satisfies indigenous consumption needs but also boost exports and makes available nutritious and hygienic food product.

The policy should also aim at generation of employment opportunities in rural areas along with establishing strong linkages between the industrial, horticultural and agricultural sectors.

It should take an integrated approach towards accelerating investment in the sector. Hence, the policy needs to address issues, which today inhibits production of appropriate quality of seeds and other plant materials.It should put in place the framework required for creation of required infrastructure, backward linkage, and setting up of R and D centers and provide assistance for human resource development. The policy must also ensure easy availability of finance, set up required mechanisms for providing marketing assistance and rationalize taxation.

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Flowers/Orchids under Cultivation in North Bengal :

Flowers	Orchids
Anthurium Andreanum	Vanda
Rose	Cymbidium
Gladioli	Oncidium
Haemanthus (Football Lily/Bulbous Lily)	Dandrobium
Eucharis	Phalonopsis
Amryllis (Tube Lily)	Cattleya
Gloriossa (Tuber Flower)	Pleione
Haemorocallis (Bulbous Flower)	
Lycoris (Bulbous Plant)	
Zephyranthus (Candia, Robusta and Sulphurea)	

In view of the commercial activities in the field of Horticulture especially in floriculture West Bengal has the competitive advantage for venturing these sectors in big way :

Presently 7,300 hectares under floriculture in North Bengal hills and South Bengal & it has to be substantially increased.Agro climatic condition ideally suited for floriculture activities—October to February lean season in Europe/ Japan, suitable for production in West Bengal.

- Airports at Bagdogra and Kolkata strategically located.
- Technical expertise & consultancy are available due to the presence of Two Agriculture Universities & general Universities.
- Required: Suitable post harvest infrastructure and sufficient volumes & proper domestic & export market logistics for backing up the entrepreneurs.

Why Hi-Tech?

- Flowers grown under open condition have not attained the set up standards for export.
- High-tech production technology is inevitable and must for export orient production.
- Green house production is the basic of high-tech production technology.

Components of High Tech Production Technology :

- Improved plant materials, acceptable in international markets.
- Improved agro-techniques.
- Improved plant protection measures.
- Cost-effective construction of green house.
- Simulation of ideal environments for growing particular crops.

The Gerberas :

Variety :	Ruby Red, Sangria, Sabanah, Solero, Himalaya, Winter Queen, Golden Gate, Thalassa, Venturi, Ornella, Cabana, Caressa, Pink Elegance.

Soil : Loose soil with good drainage pH : 6–7

Irrigation : Depends on soil type, light intensity, plant age. Watering is done in morning. Sprinkler system is most suitable.

Light : Cool climate with good sunlight in summer 50% shade net applicable.

Sterilization : Formalin (2%) or Methyl Bromide (100g per sq m) used to sterilize soil. After applying the chemical, soil is to be kept covered with polythene for 2 days. Then cover to be removed and wash the soil thoroughly with water.

Planting : 30 cm high bed, with 60cm width, and length according to the length of greenhouse. Here 3-4 rows of plants can be planted. Spacing is 30cm x 30cm.

Planting time : Throughout the year. Best time is June-July to get flowers in winter and spring.

Growing temp. in greenhouse :

For initial growth and rooting 22–25°C

In autumn 14–17°C

In winter 11–13°C

Fertilization : 10 kg compost or FYM as basal / sq. m

N:P:K = 20:20:20 @ 1.5g / lit applied at 2 days interval (first 3 months). At flowering stage N:P:K = 15:8:35 @ 1.5 g/lit

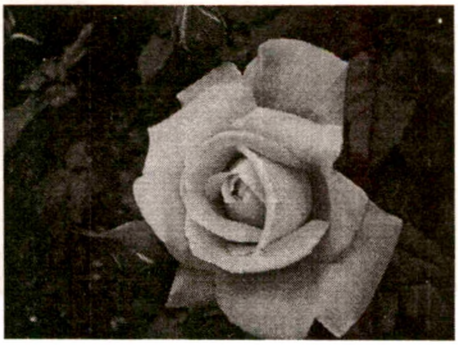
OR

N:P:K = 2:1:3 :: 290 mg : 145 mg : 435 mg per plant

Harvesting : Flowering occurs 50-60 days after planting

Harvesting done when outer row of florets are perpendicular to the flower stalk.

Rose



Variety : Hybrid Tea – First Red, Osiano, Monica, Pasi.
Floribunda – Golden Times, Flirt, Kiss, Eskimo, Vanilla, Mercedes.
Growing Temperature – Day 25–30°C
Cloudy day 18–20°C
Night 15–18°C
Light – With increasing intensity, production and grade increases.
Relative humidity – 70–75%
CO_2 – 1000–2000 ppm
Soil Peat, FYM, Compost
Planting spacing 1ft x 2.5 ft
Fertilization–Super phosphate – 2 kg
CAN – 1 kg in each sq.m as basal
Potash – 500g

A diluted solution containing KNO_3 and NH_4NO_3 may be sprayed at weekly interval.

Irrigation – Drip
Yield – Low cost poly-shade : 150-200 flowers/sq.m/year
Controlled greenhouse: – 350–400 flowers/sq.m/year

Orchid :

Growing condition-Day temperature = 11–30⁰C
Night temperature = 16–22⁰C
Relative humidity = 65–80%
Light intensity = 25–30 k lux
Air circulation = Normal

Pot – 6" with pores at sides and bottom 30–32 pots/sq. m.
Media – Soil, gravel, charcoal, coconut husk.
Fertilizers – N:P:K = 20:20:20 as 2g/lit in young plants, 4g/lit in aged plants as fertigatin.
Hybrids – Sonia–16, 17, 28, Ceazar Laura, Venus, Pompoder, Merry Macky, Sabin, B.B. White.
Yield – 6 inflorescences/plant/year and 180–200 inflorescences/sq.mt.
Cost – Production cost per infloresci nce = 6.34/-, Sale price Rs. 12.00 per inflorescence in field or Rs. 17.00 per in market.
Net Profit = Rs. 50,000–60,000 per year from 1000 Dendrobium plants in 150 sq mt. Area greenhouse.

Anthurium :

Variety – Acapama, Jewel, Lucia, Titikaca, Lipstick, Pupo, Violet, Ingrid, Tanaka, Ozaki, Surprise, Passion, Nitta, Howaii
Growing medium – Temperature – 18–27⁰C
Light Intensity – 50–70%

Relative humidity – 60–80%
Coz – 600–900 ppm
Air movement – Normal

Media – Coconut husk, Charcoal, Sawdust (1:1:1)
Spacing – 7–8 plants/sq mt. Planting done before or after rains
Fertilization – N:P:K = 20:20:20 @ 1% per week, once
Watering – Nigh amount. Twice per day
Yield – 20-40,000 flowers/bigha/year (1st 3 years)
40-80,000 flowers/bigha/year (4th to 7th years)

Flower Size and Price :

Spathe Size	Stalk Length	Grade	Cost/Flower
below 5 un	20-25 um	Very small	Rs. 6-8/-
5-7 un	25-30 um	small	Rs. 8-10/-
7-9 un	30-40 un	medium	Rs. 12-15/-
9-12 un	40-50 un	large	Rs. 18-20/-
12-15 un	50-60 un	Very large	Rs. 22-24/-
Above 15 un	60un and above	Extra large	Rs. 25-30/-

Carnation :

Variety – Rubesco, Memory, Memory, Neeva, Trendy, Asiana, Montehuma, Cobra, Salsa, Dotcom, Fresh Mint, Super Green

Soil – Land prepared upto 40 um depth. Loam or sandy isam soil ideal pH–5.5–6.5 soil sterilized with methyl bromide.

Growing condition–Temperature :	Day 28°C Night 16–18°C
Relative humidity–at initial stage	80–85%
At final stage	60–65%
Light intensity–high light intensity.	
At high temperature	30–40%
Light intensity is to be reduced.	
CO_2	800–1000 ppm
Planting–Bed	15–20 mm high 1nt wide 50 cm wide path

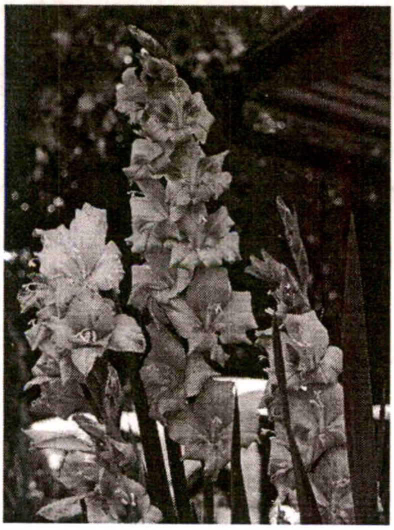
Fertilization –

Nitrogen –	250g.	Applied at 15 days interval in
PO_4 –	60g.	1×9 mt in split doses
K –	200g.	
Ca –	125g.	
Mg –	40g.	

Irrigation – Drip irrigation most suitable Misting at initial stage required.

Harvesting – In morning, with sharp knife keeping the stalk length in accordance with market demand.

Gladiolus :



Variety – Hunting song, Peter Pears, Novalux, Friendship, White Friendship, Golden Game, May Bright, Memorial Day, Superstar, Nichole.

Soil – Use drained loamy or sandy loam pH 6-7, Low level of chlorine

Fertilizer – N:P:K = 12:12:18 applied @100g/sqm Or N:P:K = 5:7:4 applied @30g/sqm

Growing Condition :

Temperature : 10–25°C

Light : 1000 Joule/sq.m each day until flower initiation

Bulb Planting : September–November

Spacing : 20×20 cm, depth–12 cm

Irrigation : As per requirement 2–3 times per week

Yield : 250000 spikes/ha

Price : Depending on Variety, Rs. 24–80/- dozen

Chrysanthemum :

Variety—Dignity, Snowball, Chandrama, President, Vigour, Temptation, Tokyo, Peter may.

Growing condition—Light for vegetative growth—long day required length of light duration controlled by artificial light, black polyethylene.

For flowering–short day required.

Temperature – Night 10–25°C
– Day 16°C or above

Air	– CO_2 amount high
Soil	– Well drained, acidic soil containing organic nutrients
Irrigation	– In adequate amount. 3–10 days interval according to soil type and climatic condition.
Cutting preparation	– Source–disease free mother plant. Ideal cutting: 4–6 cm long, 3–5 mm diameter Growth regulators–IBA or NAA rooting occurs within 10 days, transplanted to main field in 15–20 days.
Planting time	– July–August (in hills), October–November (in plains)
Spacing	– 30 plants/sq. mt.
Fertilization	– 40gm Nitrogen, 40gm PO_4 as barn, 20gm K_2O
Disbudding Pinching done Yield	– 50,000 flowers/bigha greenhouse

MULLICKGHAT FLOWER MARKET :

Largest Flower Market in Eastern India

Flower	Price/kg (Rs.)	Sales price/kg (Rs.)	Production area
i. Large Marigold	6-7	5-12 (depending on Supply & Demand)	Panskura, Bagnan, Micheda, Ranaghat
ii. Red marigold	6-7	12	,,
iii. Garland with large marigold (40-50 flowers)		60/20 pieces	,,
iv. Basanti Marigold		70-80/20 pieces	,,
v. Garland with red marigold		35/20 pieces	,,
vi. Annual Chrysanthemum	4–5	2-8/kg	Bagnan, Kolaghat, Mecheda, Panskura
vii. Red rose	70-80 /25 picees	90-100 /25 picees	,,

AN OVERVIEW ON BIORATIONAL PEST CONTROL AGENT WITH PEST MANAGEMENT SCENARIO IN ROSE

Ashim Chowdhury and Ujjal Kumar Pati

Introduction :

Rose belongs to the family Rosaceae with many wild and cultivated species. Modern roses are derived from Chinese and European roses. As a result of crosses, several types like Bourbons, Portalands, Noisette and later the hybrid perpetual were produced and have become popular. There a large number of cultivated species are seen in India. But our main aim is now to sustain this development as well as to provide nutrition & economic self-sufficiency to our farming community, is possible through Agricultural/horticultural growth. The importance of agriculture in Indian economy—contributes about one third of the GDP and 74% of the population live in rural areas. Agriculture is virtually the only occupation. 64% of the Indian workforce is engaged in agriculture. Large capital outlays coupled with sustained efforts have helped create extensive irrigation facilities, rural credit delivery mechanism and deficient modern farming methods.

Floriculture Significance and Potential :

The world trade in cut flowers exceeds 56 billion of which India's share is just 0.1%. There is a booming market for this product in West Europe, and some parts of India are ideally placed to cater to this market. October to February is a lean season for flower production in Europe (because of the snowfall) while this period is perfectly suitable for production in India. With proper investments in the sector, India has the potential to capture a huge share of the world market. West Bengal is well placed to exploit this opportunity because its agro climatic condition and abundant water supply is ideally suited for floriculture activities, offering a natural advantage for the commercialization of flora, especially in North Bengal & also in South Bengal. Further, airports at Bagdogra and Kolkata are strategically located in the northern and southern parts of the state respectively, providing the vital transport link—a crucial requirement for this sector. Because of these factors, the sector has the potential to be viable if necessary investment is made in the cultivation (greenhouses, irrigation system etc.) and cold chain infrastructure.

Historically speaking, Darjeeling hills of North Bengal have played a pioneering role in the development of floriculture in India. In fact, nurseries at Kalimpong, in Darjeeling, were among the first to export floriculture products from India to USA, UK and other European countries. With over 40 nurseries and 50% farmers engaged in floriculture, Kalimpong is the leading exporter of such products in Eastern India. In spite of inadequate infrastructure, exports worth Rs. 21 million (USD 0.46 million) takes space from small nurseries here. Cut flowers like Gladioli, Anthurium, Cymbidium, Gerbera are sold mainly in the domestic market, while planting material for these flowers are sold both in the domestic market and are exported to countries like Holland, Japan, Germany, Thailand, Italy etc.

Cut flower cultivation is also actively done in South Bengal. However, the species of flowers grown are not of exportable variety and are consumed mainly in the local market.

The main activity pertaining to floriculture in South Bengal is restricted to dry flower processing. Most of the dry flower processing is done in and around Kolkata—the capital city, with Kolkata Port accounting for about 70% of India's export. From here, over 500 varieties of dry flowers and pot-poultries are exported mainly to Western Europe.

To ensure availability of quality produce at optimum prices, the concept of contract farming may be adopted. Contract farming supplemented by production from captive farms is the only possible solution to enable industry to be independent of raw material sourcing uncertainties. The present cold storage capacity of 4.5 million tones in the state is mainly meant for the preservation of potatoes. What the state needs today is multi chamber cold storages with separate temperature and humidity control devices for fruits, flowers, vegetables etc. It is recommended that the government should not fix tariff for any stored item and that market forces should be allowed to determine storage charges.

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Lycoris (Bulbous Plant)	
Zephyranthus (Candia, Robusta and Sulphurea)	

In view of the commercial activities in the field of Horticulture especially in floriculture West Bengal has the competitive advantage for venturing these sectors in big way. Presently 7,300 hectares under floriculture in North Bengal hills and South Bengal & it has to be substantially increased. Agro climatic condition ideally suited for floriculture activities—October to February lean season in Europe/Japan, suitable for production in West Bengal.

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- Technical expertise's & consultancy are available due to the presence of Two Agriculture Universities & general Universities.
- Required: Suitable post harvest infrastructure and sufficient volumes & proper domestic & export market logistics for backing up the entrepreneurs.

Since intensification of agriculture is a strategy to generate additional food, it is expected that year round cropping will encourage more pests (insects, disease pathogens, nematodes, weeds, rodents, birds, etc.) in the future. Because of favorable growth and multiplication conditions offered by a tropical country like India, pests assume serious proportions throughout the year. It is, therefore, not surprising that losses due to pests are far greater in the tropics and semi-tropics than in the temperate regions of the world. It is estimated that around 36% of the attainable, agricultural/horticultural output is lost due to various pests. Pest management is a powerful strategy that can handsomely contribute to enhancement in crop productivity. Nevertheless, pest control with heavy dependence on treatment with insecticides and pesticides is fought with dangers because of their harmful effect on environment and well being of man and animal. Pesticide use in India has increased from 2,936 tonnes/annum to 98,000 tonnes/annum in 1997-98 which at the present levels is far less than the countries like China or Japan.

Intensity of Pesticide Consumption in Different Countries :

Country	Pesticide Consumption (gm a.i/ha)
USA	3000
West Germany	3000
Mexico	750
Japan	7000-9000
Taiwan	10000
Korea	6000
India	450-500

1. Less use of pesticides than other countries does not justify increasing their use indiscriminately, because whatever is currently applied is appropriated by a few crops only, e.g., cotton 54%, rice 17%, vegetables and fruits 13%, plantation crops 8% and all remaining crops 8%.
2. Irony of the situation is that increased pesticide dependence aggravates their use because: (i) native pests develop more virulence against them and (ii) the natural enemies which would have maintained an auto-control on pest spread also fall prey causing pest resurgence and infestation by previously harmless secondary pest species to them.
3. Above all, increased pesticidal use leaves not only more harmful residue in the produce, but persistence in soil and water manifests their ill effects long after their application.

Although pesticides have become an integral part of modern agriculture, their excessive and non-judicious use has not only resulted—

a. environmental pollution
b. also developed resistance to several pests, caused pest resurgence
c. adversely affected beneficial organism like honeybee, pollinators and natural enemies like parasites and predators.

Chemical methods of pest control have a fantastic transformation during the last 50 years from 1st generation to present generation. Up to mid 70's chemical plant protection had been found to be spectacularly successful mainly due to insecticides then comes fungicides and herbicides etc.

To be environmentally benign, they should be biodegradable, capable of reducing the damage level and safe to fishes, bees, pollinators and other non-target organisms. From human and environment safety point of view, several countries have banned the use of such pesticides that are toxic and whose residues persist for long duration in food commodities, soil and aquatic environment. For such reasons, the Government of India has banned 20 pesticides which besides being toxic were damaging the environment. The use of 18 others has not been allowed so far. The fate of 13 others is under review and another 9 pesticides have been permitted for restricted use only.

It is estimated that by the year 2010 about 20-30 per cent of the present day pesticides will be replaced by bio-rational agents. However, pesticides will continue to remain as one of the main weapons in the hands of farmers to control pests, particularly weeds, nematodes and diseases. Keeping pace with the time, when environmental issues are agitating our minds, it should our endeavor to replace completely the conventional pesticides with safer products of synthetic, botanicals or biological origin. Development of safe delivery systems and management of hazardous pesticide wastes and toxic residues are some other important areas of pesticide management, in other words, pesticides for the future should be in the true sense, green pesticides. Having taken cognizance of the hazards associated with obsolete pesticides, scientists throughout the world are engaged in looking for environment friendly pesticides that can provide safe and efficient crop protection options. There is research trend worldwide by the Universities, research organization & Industries for the development of new group of crop protection chemicals with different mode of action high biological activity, specificity, low toxicity & ecotoxicity & low risk of inducing resistance in pests. In recent time's number of break through has been occurred in respect of Biopesticides with particular reference to Botanicals, microbial pesticides, pheromones, IGR & new more promising crop protection agents etc all are important components of plant protection & biotechnology.

In view of the various transformation of agrochemicals since last more than 50 odd years, it has been felt by all that new generation of agrochemicals should be introduced as crop protection agents due to many reasons viz;

1. Resistance problems.
2. Environmental hazards.
3. Biological adaptation of harmful organism etc.
4. Quality consciousness of the consumers.
5. Quality monitoring.
6. Acceleration/Sustainability of production

This prompted for developing safe, target specific, new mode of action, ecologically friendly agrochemicals for effective crop protection in all over the world. With the advent of Integrated Pest Management especially, there is a need of new generation of chemicals, which are befitting for execution of this concept. Some of these groups are:

Insect/Pest/Disease of Rose:

Like any other plant, the rose has its own enemies, some of which assume more serious proportions in one part of the world than in other. The majority of the rose pests are not specific to roses and they attack and feed on quite a number of plant species besides the rose.

White Ants or Termites (*Odentotermes obesus*):

Nature of the damage : The destroy the underground parts including the roots of the young as well as old plants. Sometimes it is found that apparently healthy looking rose plants appeared to wither and cuttings fail to sprout.

G-146909

Management :

The best measure to avoid damage is to apply Chloropyriphos, dust in peats before planting. Drenching of rose bids with chloropyriphos 4ml/L also control it. Imidacloprid, a Neonicotenoid will be very much effective for termite control.

Aphids or (*Macrosiphum rosaeformis*) plant lice :

Nature of the damage : The buds and flowers get disfigured and wither away. This small green insect appear early in the spraying and feed on the tender shoots, buds and flowers. They damage the plant by shucking the plant sap. Flowers when attacked become malformed.

Management :

Pyrethrins (Pyrodust) may be applied at 0.2% level to destroy this. Spraying Matasystox 0.1–0.2% (1 ml/lt), a systemic poison get absorbed into the sap and the whole plant sap is poisoned, the effect lasts for 2–3 weeks. The aphids can be easily controlled by spraying Malathion (0.1%) or Rogor (0.1–0.2%) & some generation systemic insecticides. Fumigation may also prevent aphids (Methyl bromide) and combined fumigation (Methyl bromide and Phosphine) in cut (Son *et. al* 1998a).

Thrips (*Rhipiph phorothrips cruentatus*)

Nature of damage : It inhabit the undersurface of tender leaves and suck sap from leaves, flower buds, Mottled and deformed the young leaves with brown or silvery patches or burned margin and deformed flower are the main site of attack.

Management :

It can be controlled by B. H. C., Lindane etc., Spraying of Metasystox can control them. Hessayon, 1981 suggested spray with Fenitrothion, Malathion to control thrips. Carbofuran 3G was applied at 0.03–0.06, 0.09, 0.12, 0.15 and 0.18 g.a.i./pot, for control of thrips.

Jassids(*Empoasca*spp.) Leaf Hoppers

Nature of damage: The leaves lose their natural colour and become dull-whitish yellow, and subsequently dry up; the damaged plants have a sickly appearance.

Management :

It can be controlled by spraying Carbaryl. It can easily be controlled by spraying 0.1% Metacid or 5% Thimet as soil application (Prasad and Verma, 1980). The use of 0.05% Monocrotopos is also effective in controlling Jassids.

Chafer Beetles: (*Oxycetonia versicolor*) and (*Adoretus versultus*)

Nature of damage : Adult beetles feed on the leaves at night, irregular cuts and punctures of the leaves are noticed.

Management :

Metacid spray at 0.2% (2 ml/Lt) on the leaves, application of BHC kill the nocturnal beetles.

Red Scales (*Aonidie llaaurantii*)

Nature of damage: Reddish brown waxy scales appear like pox marks on the tender shoots and stems; the affected portions dry up.

Management :

Application of Malathion (Emulsion, 0.1%), Carbaryl, Carboxin, 0.25%), and Diazinon (Emulsion, 0.1%) will prevent this. Spraying the affected plants with insecticides like malathion, rogor will control the insect (Pal, 1972, Pirone et al., 1960). Application of granular insecticides like carbofuran at 1.5 kg a.e./ha and disulfoton and phorate at 3.0 kg a.i./ha also gave good control of rose scales (Srinivasan et al., 1974). Use of Permethrin contained in biocide is also very effective (Hessayon, 1981).

Mites :

Redspidermites (*Tetranychustelarius*):

Nature of damage: Reddish brown encrustation on and at on the younger shoots also. Several pox-mark scales appear on the shoot and park get covered with layers of overlapping scale. The branches become dry when severe.

Management :

Spraying of Metasystox will control the mites. Several acaricides viz; Dicofol, Dimite have been reported to be very effective in controlling spider mites (Pirone et al, 1960; Ramakrishna, 1984). Spraying the affected plants with 0.05% parathion (Pal, 1972 or 0.1% metasystox (Misra, 1981) is also suggested. Omite,fenazaquin supposed to be effective. Thuringiensis was effective in controlling spider mite, but there were no significant differences between azocyclotin, dienochlor and thuringiensin (Ochoa et al., 1990). Diafenthiuron was highly efficiently at 40 and 30 g a.i./100L. In controlling spider mites. Mortalities obtained were comparable with those obtained with abamectin at 3.6 g a.i./100L of water (Aquiar et al., 1995). A concentration of 0.20 to 0.25% cinnamite controlled two-spotted adult spider mites and eggs by 80% and 100% respectively (Parrella et al., 1999).

Nematodes :

Root-knot nematodes (*Meloidogyne trapla, M. incognit*)

Nature of damage : Malnutrition, decrease shoot growth and leaf chlorosis (Pirone et al. 1960). Flowering is adversely affected.

Management :

Soil fumigation with DD (a mixture of 2, 3-chichloropropane and 1, 3-dichloropropane), EBD (Ethylene dibromide) or DBCP (1,2-dibromo-3-chloropropane) is very effective in controlling the nematodes. Dormant budded rose rootstocks from a nursery infested with *M. hapla* were washed and dipped for 30 min in 0.1% prophos or nemacur [ethyl 4 (methylthid)-m-tolyl isopropylphosphoramidate] at 160C. *M. hapla* was eliminated by either treatment without phytotoxicity (Dale, 1973).

MITE :

Technical	Brand	Dose	Recommendation
Dicofol	Colonel-	2ml/lt	In winter season or in low temp. 15 days interval 2–3 sprays but during Summer season/high temp./high infestation 2–3 sprays at weekly interval. It is always better to use other acaricide like sulphur etc in between Continuous spray of Dicofol.
Sulphur	Share	4ml/lt	Unique sulphur formulation in flowable (S.C) condition. When mite is in low to moderate stage (2–4 milte/leaf) sulphur will give very good Control. But remember that sulphur is advisable to use when temperature is below 30°C.

INSECT : Caterpillar/Borer

Technical	Brand	Dose	Recommendation
Lambda-cyhalothrin	Agent Plus	0.5 ml/L	This is purely contact and latest generation synthetic pyrethroid. Try to use before the pest fully entered into flower/petals.
Novaluron	Rimon	0.75-1.0ml/lt	This is a chitin synthesis inhibitor and environment friendly IPM certified Molecule. Excellent in efficacy if applied properly. Apply when the pest Infestation is only 1–2 larvae/plant, Control duration is usually much more than other molecule.

INSECT : Thrips

Technical	Brand	Dose	Recommendation
Alphamethrin	GEM	0.5ml/lt	As usual
Lambda-cyhalothrin	Agent Plus	0.5ml/lt	As usual
Imidacloprid	Atom	0.3ml/lt	

INSECT: White fly

Technical	Brand	Dose	Recommendation
Imidacloprid	Atom	0.3 ml/lt	
Acetamiprid	Lift	20 g a.i/hac	

INSECT: Scale

Alphamethrin, Quinalphos, Lambda-cyhalothrin etc.

Root-lesion Nematodes (*Pratylenchus penetrans* and *Pratylenchusvulnus*)

Nature of damage : They cause root decay and affected plants become stunted and chlorotic having leaves with low amount of iron, copper and potassium (Jakobson, 1975).

Management :

Beuzenberg (1972) studies the efficacy of three nematicides namely nemafos, nemagon and temik (aldicarb) on Garnett roses and found to be very satisfactory. Treatment with fenamiphos at 100 and 200 ppm for 10 minutes and it 50 ppm for 30 minutes, achieved 100% control of *P. vulnus* (Veldetal.,1998).

DISEASES

Roses are attacked by several diseases, some of which can be very destructive. Except for a few cases where the casual agent may be a virus, bacterium or nematodes, most diseases of the rose fare incited by fungi.

Fungal Diseases

Die-back: (*Diplocarpon rosae, Leptosphaeria conyothryrium* and *Diplodiarosarum*).

Dice back is one of the major diseases of rose particularly in India. The name indicates, the disease causes death of plant from top to downwards. The stems and roots of the plant show browning of internal tissues. The old plants are more prone to attack of the disease as compared to young ones.

Management:

The common control measure is to cut away the affected parts and burned it. The secature should be disinfected with spirit and the cut ends immediately with a paste containing 4 parts of copper carbonate, 4 parts of red lead and 5 parts of linseed oil, 0.1% BHC. Some systemic fungicides like carbendazim (1g/lt), metalaxyl, Iprodione, Pancycuron may also be effective as soil drench.

Powdery Mildew (*Sphaerotheca pannosa* var *rosae*)

This major disease of rose, causing much damage to roses all over the world. The symptoms are the infected leaves become curled and dwarf, turn purplish, wither and fall prematurely. Buds may not open and get distorted or dwarfed. A white to grey powdery or felt like mass appears. The mycellium and coniflias are superficial.

Management :

The affected plant may be treated with 80% elemental wettable sulphur. Triforine, bupirimate and sulphur have the preventive effect. (Gamboa et al. 1980). Modern fungicides like benlate, bayleton, bavistin, agrozim, calixin, meralaxyl etc have been found very useful (Jobson and Haman, 1978), Ramakrishnan 1984, Dharam Vir and Sharma 1985). The best control of the disease was obtained with the highest conc (1ml/lt) of hexaconazole applied at 8 days interval (Perez-OlveradnLozoya-Saldana1994).

Black spot (*Diplocarpon rosae*)

It is characterized by conspicuous circular dark brown to black spots, less than 1 cm in diameter with fringed margins present on both sides of the leaflets. The spots multiply expand and join together. At a latter stage, the leaves become yellow and fall. It felt uncontrolled the whole stem is defoliated and the plant become weak. Leaf buds are not properly developed and the flower buds are also affected.

Management :

The affected plant may be treated with wettable 80% sulphur, 75% Ferric dimethyldithiocarbamate, N-(trichloromethyl-merapts)-4-cyclohexene-1,2-dicarboximide (83%) (Captan) and a mixture of ferric dimethyl dithiocarbamate 75% and wettable sulphur. The best control was obtained with chlorothalonil (as 500 SC), tetraconazole (as eminent), and difenconazole (as score 250 EC) followed by triadimenol (bayfidan 250 EC) (Wojdyala 1994). The most effective treatments for control of black spot in rose were combination of formulated rapeseed oil (temmoin) with $NaHCO_3$ and KH_2PO_4, resulting in an efficacy >90% (Osnaya-Gonzalez et al., 1997). Carbendazome was the most effective fungicide to control black spot.

Leaf spot (*Alternaria alternata* and *Cercospora spp.*)

Conspicuous circular, black spot with fringed margin are seen on the upper surface of the leaves. Such leaves drop prematurely.

Management :

Spraying at weakly intervals with captan or zineb (2000 ppm) has been recommended for its control (Dharam Vir and Sharma, 1985).

Stem blight (*Diploria rosarum* and *Cryptosporell aumbrina*)*

Brown to black spots is seen on the stem.

Management :

Spraying of copper oxychloride at 0.3% (3g/lt) may be effective. The most effective by regular spraying of captan (2000 ppm) i.e. N-(trichloromethylmercapto)-4-cyclohexene-1, 2-dicarboximide (83%).

Botrytis blight (*Botrytis cineria*)

Certain hybrid roses are succeptable to this diseases which prevents the blooms from opening. Buds turn brown and decay. Sometime open flowers are attacked. Petals turning brown and shrivelling (in rainy season).

Rust (*Phragmidium* spp.)

The infected parts show small, brown-black rust pustules on the leaves, petioles and stems. The leaves within and fall early.

Management :

The affected parts are treated with a mixture of hexaferb plus wettable sulphur. (i.e. mixture of ferric dimethyl dithiocarbamate 75% and wettable sulphur control consists of occasional application of follpet, maneb, thiram or a mixture of ferbam and sulphur. (Pirone et. al., 1960; Hunt, 1973). Weekly sprays of cycloheximide, RP-26019 (iprodione) and triforine gave adequate control of *P. mucronatum*. Vitavax (Oxycarboxin) gave excellent control with only 3 bi-monthly sprays (Wallace and Yule, 1977). Spraying with Zineb (2000 ppm) at fortnightly intervals was recommended for the control of rest (Dharam Vir and Sharma, 1985).

Virus Diseases : Rose Wilt (*Marmor flaccumfasciens*)

The first symptoms appear in the form of recurring of leaflets at the tip of young shoots which are brittle. Defoliation may happen, with leaves turning yellow and falling off. The stem also gets infected and the whole plant dies.

Management :

The affected plants should be removed and burnt. (Harkness, 1979).

Rose Mosaic Virus

Rose mosaic occurs mostly on greenhouse roses. Chlorotic areas along with midribs of the leaflets and localized distortion are the principal symptoms. Sometimes one finals ring and water mark pattern. Virus causes brighter and light yellow patterns.

Management :

Diseased plants should be destroyed and never used for propagation (Pirone et al., 1960).

Yellow Mosaic Virus

Infected plants show yellow sands adjacent to vain.

Management :

The inflected plants should be destroyed and only healthy sources of bud-wood be used.

Disease Problem :

Disease	Product	Dose
Black leaf spot	Indofil M-45	3–3.5g/lt, better as prophylactic, Also supplies Mirconutrient like Mn (18%), Zn (2.5)
Black leaf spot	Companion	Companion 2–2.5g/lt, better as prop-hylactic but also worked as curative
Die back	Companion.	2.5–3.0g/lt, better as prophylactic but also worked as curative.
Powdery Mildew	Share or Sitara	4ml or 1.5ml

NATURAL PRODUCT :

Tobacco :

Two species like *Nicotirra tobaccum* and *Nicotina rustica* , having alkaloid is very effective for controlling several pests.

Formulation using 1 kg of waste tobacco, boiled-1/2 hr in 10 lit of water after sieving, 14 g of soap powder in 30 lt of water be added in this decoction to improve the spread ability 4.5 lt of decoction. This material is very effective against of any borer, caterpillar, aphids, mites, lice spider etc.

Datura (*Datura stramonium*) :

Here the entire plants parts can be used. 1 kg of plant parts are soaked in 10 lt of water. Add 20 ml Kerosene and 50 g a soap powder. This should be kept overnight for necessary soaking. Now this is passed through a fine cloth and spray.

This is effective against Alternaria, Nematodes, Pentalomid bugs, Red cotton bug, Rusts, Borers, Catterpillars.

Neem (*Azadirachta indica*) :

This is very effective due to insecticidal property. The plant parts contain azadirachtin which is well known for its insecticidal properties. Neem seeds are also most effective.

Usually 500 g seeds are crushed and soaked overnight in 10 lt water. Now add 15 g of caustic soda or soap powder in it. Strain through a cloth and spray. This is very effective against all soft bodied pests. Aphids, Jassids, mites, nematodes etc. Neem formulation especially Azadirachtin based may be more effective.

Garlic (*Allium sativum*) :

Garlic has essential oil which contains allicin. This Allicin is pest repellant. A preparation is made by soaking 85 g garlic clovers in 50 ml kerosene for 24 hrs. A second preparation is made by adding 10 ml soap solution in 450 ml water. Mix them and shake vigorously. Strain through cloth and store in stoppered bottle. While spraying use 50 ml extract with 950 ml water.

Castor (*Ricinus communis*) :

Castor seeds contain toxic substance called Ricip. This should not be fed to cattle. Seeds cake is good for manure. This works well against Aphids, jessed, Bugs etc.

Citronella (*Cymbopogan mrdus*) :

Citronella oil repels pest due to its strong odour.

Marrigold (*Tagesto serecta*) :

In a drum, the plant parts to be soaked for 5 to 10 day. Stir in b/w. Add 30 to 40g soap and spray. It controls aphids, flies, Mur, Nematodes etc.

Conclusion :

The rose, because of its utility, occupies a pre-eminent place amongst the flowers crops and is one of the oldest of fragrant flowers to be cultivated by man.

Its different types having beautiful flowers of exquisite shape, different sizes, bewitching colours and most delight fragrance has made it important flowers for its varied use.

It can be used in various ways viz; cut flowers, garden display, pot plants, perfume & allied products-rose water, gulkund, Pankhuri, sources of vitamins.

Some more value added products viz; rose vinegar, rose petal wine, jams, jellies having some digestion & curative properties. Fruits of some wild rose are used for preparing a hot drink like tea & a popular wine.

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Now in view of the growth of horticulture in order to back up the economic development of the State under new vision, the floriculture must take a dominant role especially the rose sector not only as flower but also as processing followed by value added products.

The technical expertise, consultancy & all the important inputs are very well available in the State. The logistic for domestic & export market should have been organized followed by processing & value addition unit through the entrepreneurs for high value products.

The products must have good quality; very much competitive to the markets at all levels.

POST HARVEST HANDLING MANAGEMENT OF CUT FLOWERS

R. S. Dhua

Preamble :

Cut flowers are high valued and mostly perishable. The qualities of cut flowers are remaining best at harvest and deteriorate as time passes from harvesting. The respiration rate of a flower that determines how long a flower will sustain life. To delay the onset of deterioration of harvested flower and to maintain the quality, a proper temperature management is a prerequisite.

The rate of respiration of cut flower is directly dependent on the temperature. The higher the temperature, the higher is the respiration rate. Conversely, lower temperatures will slow down the respiration rate and other metabolic activities which in turn will provide prolonged shelf life of cut flowers. Therefore, it is obligatory to maintain the cold chain to maximize fresh cut floral life. The high temperatures promote rapid depletion of carbohydrates in fresh cut flowers which creates another adverse affect on fresh cut floral life. To maximize life, the rapidly depleting carbohydrates need to be replenished continuously. Besides, the flowers are also perishable due to one or more of the following reasons viz., attacked by bacteria and fungi, normal maturation and aging, desiccation or wilting due to water stress and xylem blockage, bruising and crushing, fluctuating temperatures during storage and transit, colour loss, accumulation of ethylene, poor water quality and sub optimal cultural management. The flowers are thus required to be handled very carefully and treated adequately during pre harvest as well as post harvest period to maintain the quality.

Factors Influencing Post Harvest Longevity of Flowers :

- Genetic/Inherent Factors
- Environmental Factors
- Managemental Factors
- Harvest Factors
- Ethylene Factor
- Post harvest Factors

Environmental Factors :

1. Light
2. Temperature and Relative Humidity

3. Season/Time of Day
4. Carbon Dioxide

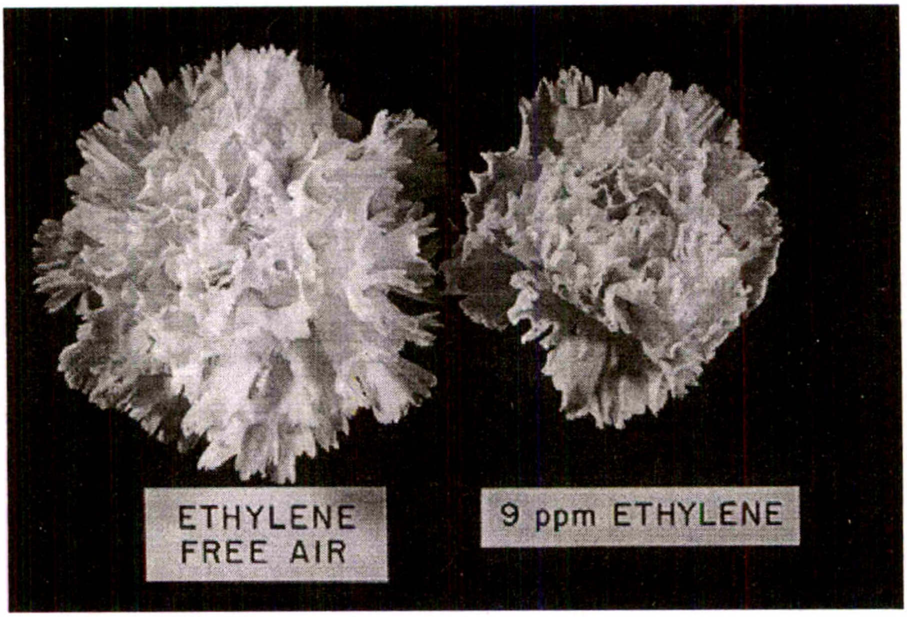
Managemental Factors :

1. Growing Media
2. Soil Condition/Mineral Nutrition
3. Irrigation/Watering
4. Effects of Frequency of Irrigation and Moisture Stress
5. Use of Agricultural Chemicals (Pesticides, Plant, Bio Regulators)
6. Diseases and Pests

Harvest Factors :

1. Time of Harvest/Harvest Maturity
2. Consumer Demands
3. Distance to Market

Ethylene Factor :



Post Harvest Factors :

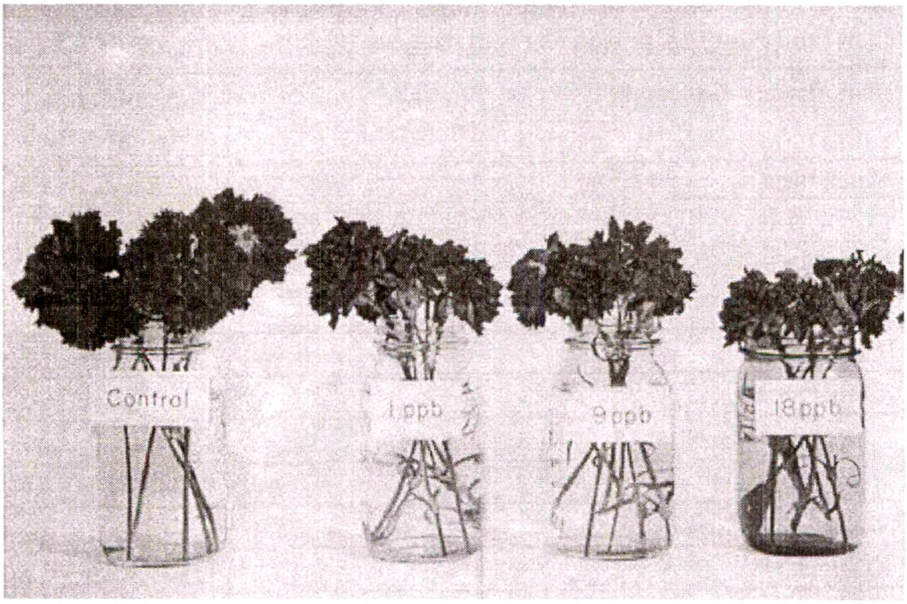
1. Storage Environment
2. Watering/Rehydration
3. Floral Preservatives
4. Air Circulation, Commodity Spacing and Packaging
5. Diseases and Pests

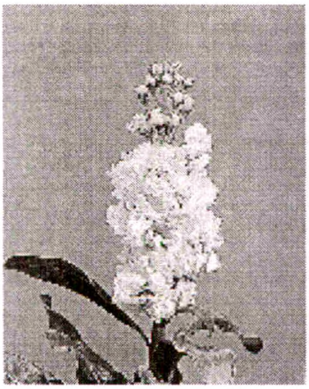
Table 1. Recommended temperature, relative humidity, approximate transit and storage period for cut flowers

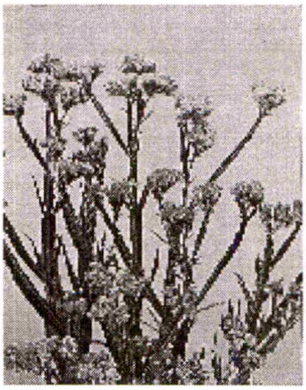
Cut flowers Commodity	Storage Temperature (°C)	Approximate storage period
Anthurium	13	2–4 weeks
Aster, China	0–4	1–3
Bird-of-paradise	7–8	1–3 weeks
Calendula	4	3–6 days
Carnation	-0.5–0	3–4 weeks
Carnation buds	-0.5–0	3–4 weeks
Carnation, miniature	-0.5–0	2 weeks
Chrysanthemum	-0.5–0	3–4 weeks
Dahlia	4	3–5
Gerbera	1–4	1–2 weeks
Gladiolus	2–5	5–8 days
Marigolds	4	1–2 weeks
Orchid, cattelya	7–10	2 weeks
Orchid, cymbidium	-0.5–4	2 weeks
Orchid, vanda	13	5 days
Rose (in preservative)	0.5–2	4–5 days
Rose (dry pack)	-0.5–0	2 weeks
Snapdragon	4	1–2 weeks
Zinnia	4	5–7 days

Post Harvest Quality of Flowers depends on

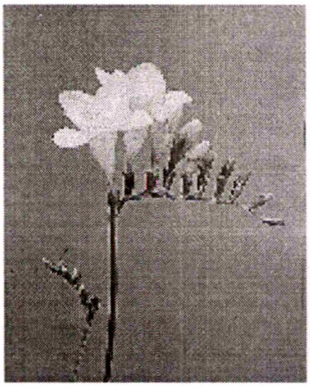
- Flower maturity
- Food supply
- Temperature
- Water supply
- Air supply
- Water quality
- Ethylene
- Growth tropism
- Mechanical damage
- Disease

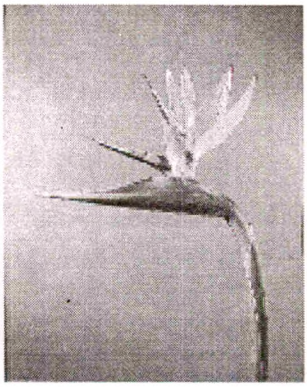


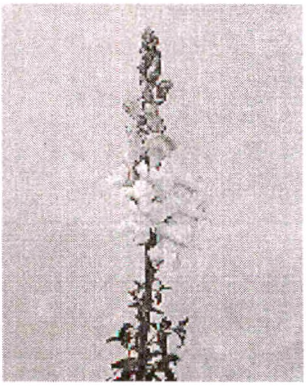

Stock

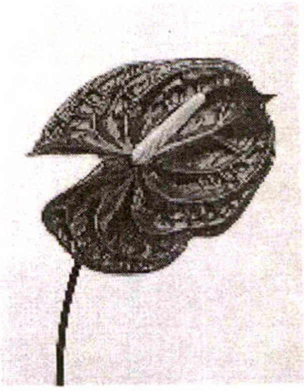

Statice

Gypsophila

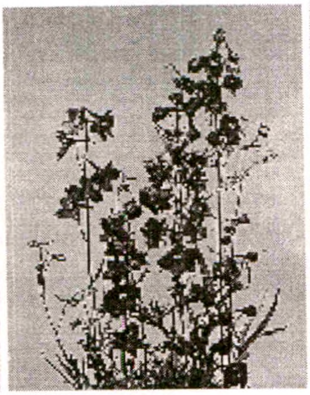

Freesia


Bird of Paradise

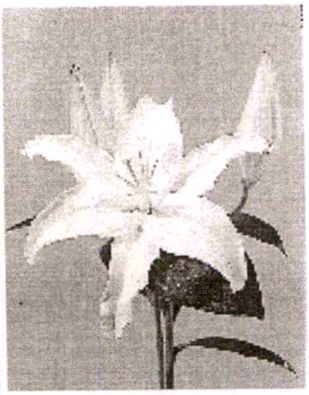

Snapdragon



Anthurium

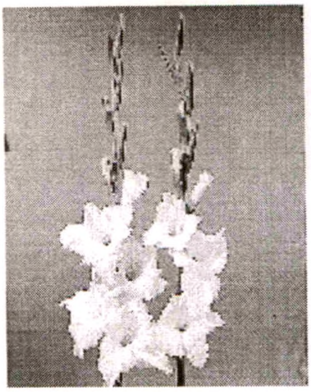


Delphinium

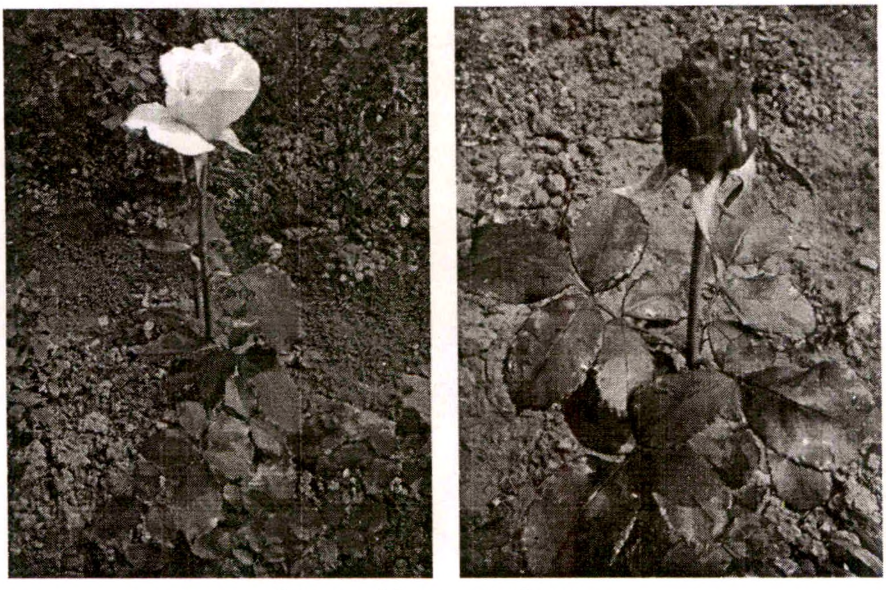


Lily

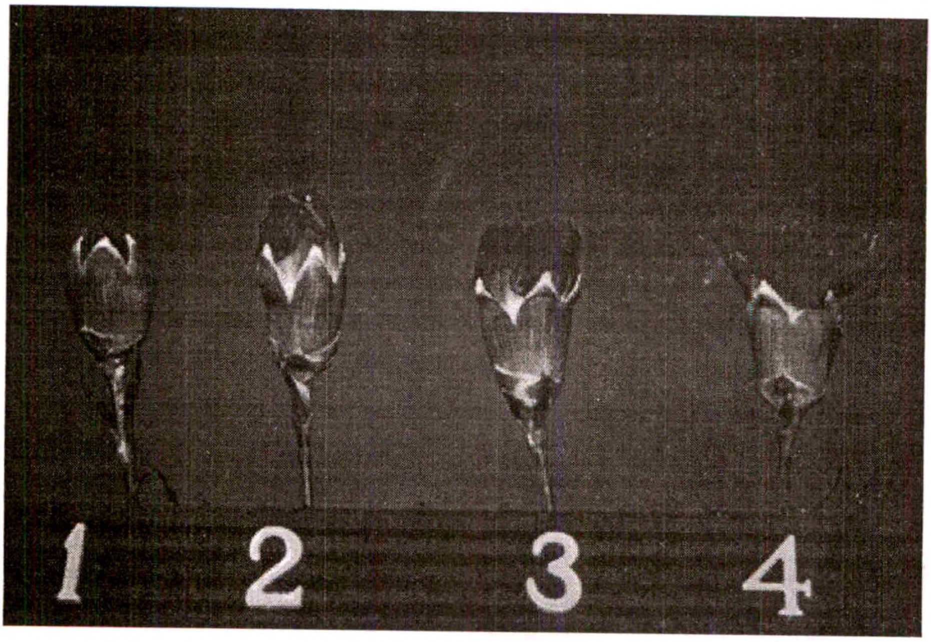
Alstroemeria



Gladiolus

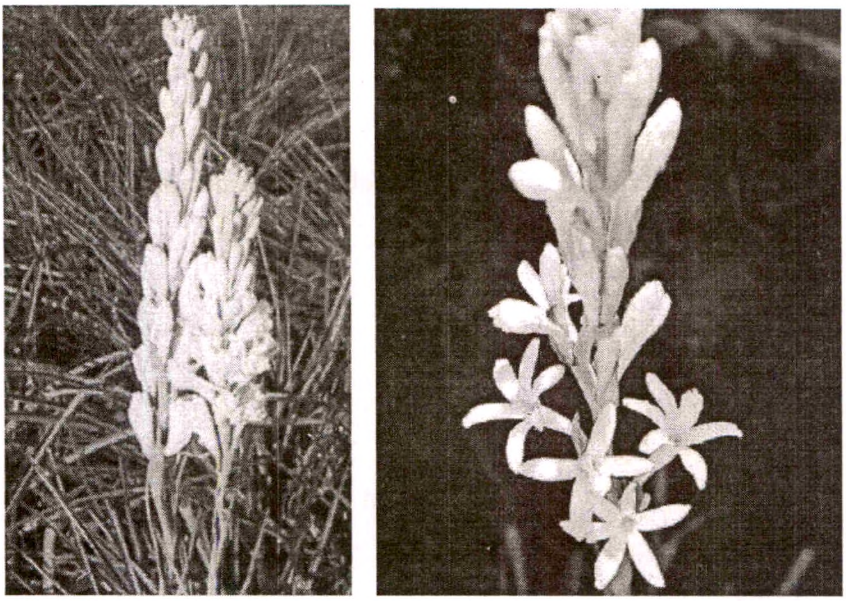


Stage of harvest of roses



Commercial Cut flowers

Commercial Cut flowers



Post Harvest Management Techniques :

Harvesting and marketing systems for cut flowers vary according to individual crops, growers, production areas and marketing systems. All involve a series of steps that may or may not be in order as detailed below but management systems should be such that maximize post harvest life of the flowers, a goal that usually requires prompt pre cooling and proper temperature management throughout the marketing chain.

Steps in Handling of Flowers :

1. Harvesting
2. Grading
3. Bunching
4. Sleeving
5. Packing
6. Pre cooling
7. Storage

Chemical Solutions :

A diverse group of solutions in which cut flowers may be placed after harvest have specific purposes :

- Rehydration
- Pulsing

- Bud opening
- Tinting
- Vase solution

Preserving Flowers :

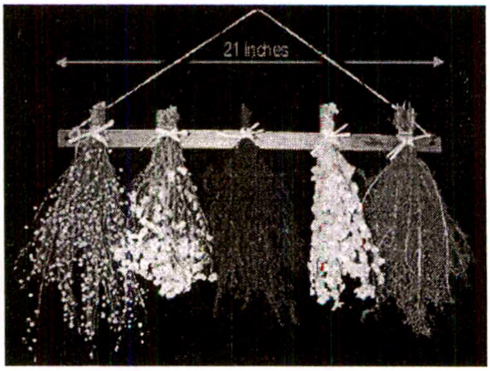
By Drying and dehydration flowers and foliages can be preserved well using various methods viz.,

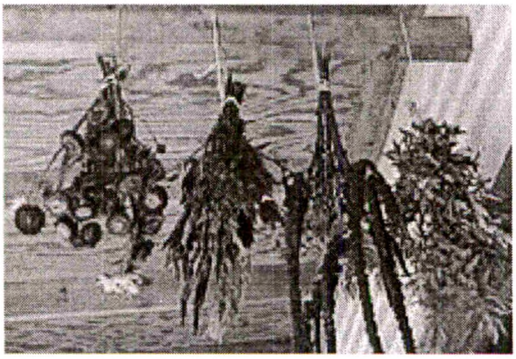
- Air Drying,
- Glycerin,
- Desiccants, and
- Pressing
- Freeze drying

It is also possible to preserve certain material using a microwave oven drying technique.

Air Drying

Flowers good for air-drying-Acroclinium, celosia, golden rod, globe amaranth, larkspur, love-in-a-mist, salvia (blue), statice, straw flower.





Air Drying

Garden flowers, as well as wild plants, can be dried simply by hanging them upside down in a warm, dry place for several weeks Flowers best suited to this treatment are the "everlastings" and a few others that do not wilt readily. Some, such as globe amaranth, can be dried in bunches on their natural stems. Others, such as straw flower, should have a wire substituted for stems before drying.

Steps for Air-Drying

Cut flowers of good quality at prime conditions or slightly immature. Remove foliage from stems. If stems are weak or become brittle after drying, remove them and wire the flowers. Group the stems into small bunches and tie with a rubber band. It will pull tighter as the stems shrink during drying. Hang upside down in a warm, dry, dark area or in furnace room. Avoid damp rooms or direct sun on the flowers. Good air circulation is important. Allow to remain until thoroughly dried. This normally takes two to three weeks.

Using Drying Agents :

Silica Gel

In general, the most satisfactory material for drying flowers is silica gel. Initial cost is greater than that of borax-sand or borax-cornmeal combinations, but it can be used over and over for many years. Since it dries flowers quickly, more flowers can be moved in and out of the mixture during a single season than in the same quantity of a borax mixture. Approximate drying time for some of the more popular flowers is when using silica gel.

Flowers :

Cosmos 2 to 3 days, Dahlia 2 to 3 days, Daisy 2 days, Gladiolus 2 to 3 days, Larkspur 2 days, Marigold 3 to 4 days, Pansy 2 to 3 days, Rose 2 to 3 days, Salvia 2 days, Snapdragon 2 to 3 days, Stock 3 to 4 days, Sunflower 2 days, Sweet pea 2 days, Verbena 2 days and Zinnia 2 to 3 days

Preserving Foliage with Glycerin :

The dried flower arrangement without foliage may seem stiff and unnatural. Leaves add much to an arrangement and can easily be preserved by a process known as "glycerinizing." This technique makes the leaves and stems soft, pliable and long lasting so they may be used over and over.

Microwave Oven Drying :

Microwave drying takes only a few minutes and provides dried flowers that look fresher and more colorful than those obtained by other methods. Silica gel as support material used during heating and drying. Heat-tolerant glass or microwave containers are used. Drying times vary from about 3 minutes for dense flowers with many petals to about 1 minute for smaller or thinner-petaled flowers. Microwave drying does not work well on flowers with thick petals. After treatment is complete, leave flowers in the silica gel for 12 to 24 hours to make sure they are cooled and dried. Since microwave-dried flowers tend to absorb air moisture, spray the petals with hair spray or lacquer. For long-term storage, keep them in an airtight container.

Freeze Drying :

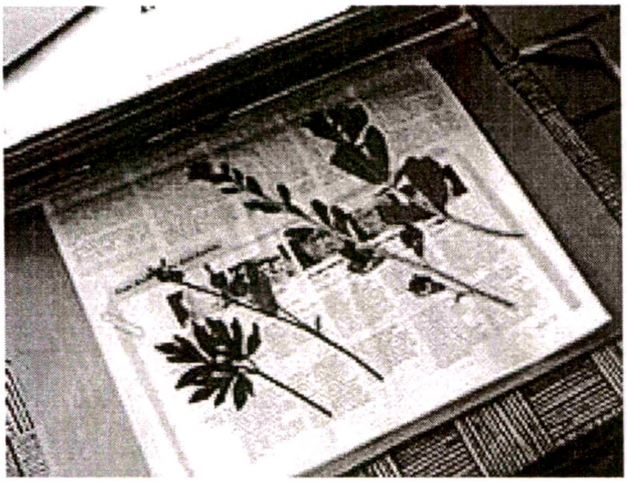
Perhaps the most effective (realistic) method of flower preservation involves freeze drying. In this process the flowers are placed into a refrigerated chamber and the temperature is lowered to below freezing. A vacuum is then created in the chamber, causing the moisture in the flowers to sublimate, or change from solid to gaseous form. The water vapor is then collected in a separate chamber and the dried flowers are allowed to slowly warm to room temperature. This process takes several days, requires expensive equipment and is best left to professionals.

Pressing :

Most flowers and leaves are suitable for pressing, excepting succulents. Flowers and foliage are pressed when the weather is dry. Any water trapped in the flowers before pressing will turn them mouldy. Commercially made flower presses, are effective for a small amount of flowers, but it may be prepared from two pieces of plywood, about 2 or 3 feet square, with four holes drilled in the corners. Four coach bolts with wing nuts are required for tightening the press. It can be prepared with plain cardboard. In home-made press, layers of blotting paper, interspersed with thick layers of newspaper can be used.

Flowers and foliage after harvesting are required to be placed at the bottom layer of press. This requires several thickness of newspaper, then a layer of blotting paper. Flowers are placed onto the blotting paper so that they are not touching each other. Always flowers of the same thickness are to be used in each layer, so that they press evenly. Covering of the flowers with another layer of blotting paper, then several more layers of newspaper is necessary. In this way all flowers are placed and finally, the top of the press is fixed, and the bolts are tightened. After a few days, bolts are again tightened, as the flowers shrink as they dry. Flowers can take between one and three weeks to dry.

Pressing Flowers :



FLORICULTURE AND WEED MANAGEMENT

S. P. Bhattacharrya

Introduction :

Traditional agriculture sometimes requires huge land and heavy investment as compared to floriculture which may be an effective tool to uplift marginal small farmers having small holdings. Commercial floriculture is economically more sound than traditional agriculture. The demand of flowers bata in the domestic and international market is enormous. In various occasion there is a treamendous demand of flowers of various colours. There is a high demand of dry flowers too. In the regime of WTO, growing of commercial flower is gainign importance. The production of quality flower is the key to achieve the goal. It is there required to have quality planting material, imiroved paesage of practice along with Integrated test Management. Some of the important flowers which have commercial value are gladiolus, Tuberose, Margigold, Rose, Chrysanthamum etc.

It has now been established that if the growers are properly trained and provided with scientific technology it is prite deossibel to earn nire tgab 50,000.00 per acre in cultivating inproved varieties of gladiolus like Snchitra, Sana, Sewatra etc. Similarly growing of rose flowering improved technology and varieties like Montechuna. Edward, Christian dena etc can fetch an income of Rs. 70,000.00 per acre. Further it has been ascertained that Marigold, an important flower having wide domestic market it can easily earn Rs. 30,000.00 per acre using the varieties like gold coin, yellow coin, Alska etc. This flower has the added advantage that it can be grown through out the year. Again Chrysenthenum which news special care for its better harvest using improved varieties like Sonar Bngal, Hamaraja, Sujata, Joya, Elegner etc earns about Rs. 40,000.00 per acre. Other flowers having commercial importance were Jasmine, Tuberose, China Rose etc.

Growing of houseplant is another important sector of Floriculture. These types of plants can not only be grown easily but also multiplication is not difficult. Further, it has got high demand in the market. It is therefore suggested to encourage growing of house plant as far as possible. Weed management is one of the meant important factors of Plant Protection in floriculture as in case of other crops. Each and every effort will be futile if proper weed management practice is not taken care of which results reduction and crop growth leading to reduction is yield of the crop finally.

Floriculture and Weed Management

Time immemorial since man started cutlivation of crops for their various needs, they noted that there are several unwanted plants associated with the cultivated one are caled Weeds. Weeds do not belong to any separate class or family, rather they are similar to the cultivated crops in nature or outlook. Weeds may either be 'absolute' or 'Relative'. Absolute weeds are always unwanted eg. Nut sedge (*Cyperus rotundus*) but Relative Weeds may be crop plants btu they are not desired under such situation where other plants are desired eg. Marigold in Rose file.d Here marigod is self Sona removoves moistured antiest of Rose plants. Further, Rogue plants are off type varieties or spp. having less economic values. These types of weeds showd be removed alogn with in crop plants infested by insect or disease organism.

Weed infestation in the cultivated field is a mammota problem for the farmers particularly under upland situation whee they grow undisturbed winter the optimum moisture, temperture and humidity. It has also been reported that 100% crop failure is not uncommon if the weeds are not controlled within the critical period. As most ofhte flowering plants are cultivated under upland situation the problem of weed is much more acute as compared to aquatic crop like Lotus, symplica etc.

It has been reported by a number of Weed Scientists that weeds remove 30–50% of mineral nutrients meant for crops plants resulting a crop loss to the turn of 50–60%. It has been also estimate that a loss of Rs. 200/- crores occurs due to weeds only. Research finding clearly indicates that about 700–1200 tonnes of water could be sared every year by keeping the weeds under control. It is also certain that weed infectation is more pronounced during the Kharif season due to intermitant rainfall, high temperature associated winter high humidity as compassed to the rabis eason crop when the weeds can't grow huminantly due to unfavourable climatic condition like low temperature compled with dry weather.

In the case of Developed and High Tech agricutlure, it is of outmost importance to keep the weeds under control from the very beginning of sowing or transplanting of crops for geeting higher economic return. Controlling of Weeds at the later growth period of the crop carries no meaning of the damage has already done during this period so far as importance of nutrients and moisture are concerned. Hence, it should be the motto of any professional cutlivator to keep the weeds under control at least during the early of the crop growth.

Practical knowledge about the specific weeds associated with the particular crop is a must and prerequite to go for management of such weeds in that crops field.

Among the different weed control measures in vogue, non chemical and chemical methods are of prime importance. But beforehand the growers must be very alert about the preventive measures, as "Prevention is better than cure". If preventive measure fails, we showed go for control measure, either non-chemical or chemical. The non-chemical method includes comprise of Agronomic manipulation hand or manual weeding and biological method.

The noncharical method should be givent op priority as compared to the chemical method, due to the reason that herbicides may lead to environment pollution in aldition to costly affair to the farmers who sometimes can't suffers such heavy someties are nto easily available in the remote village markets.

Weed Management Practice :

In general the weeds are treat under control in floriculture through mammal weeding. Earlier hardweeding was the only practice to combat the weeds, but recently due to steep rise of laboru wages weed management through hubicides is gaining importance. In case of perrenial flower cultivation weeds are managed through the use of contdictive herbicides line paraguate or glypharate @ 10.15 ml/L of water. There flowers are planted winth wider spraing, for wich haxaradous effect due to strong drift is minimum.

Further in case of annual Broadland flowering plants selective hubicide like Quinalotopethiye is Ec is quite effective in controlling grassy weeds, which is and manor problem for most of the flower garden. The broadland weeds are weeded out mammaly which is quite cost effective. On the otherhand for gladidem, Lily is narrowland crops, 2-4D Ina salt @ 0.8 kgs/ha can effectively control bradland weed and narrowland weeds are picared up through handweeding.

However, care should be taken to see that indiscrimate use of herbicide should not be encouraged to avoid residual toxicity. Ratar Indigrated weed management should be encouraged in all cases so that we can fetch better harvest both in quality and quantity which is the otherhand will help in earning foreign exchange through the ear of flowers the from residual toxicity. This system of weed management is not only ecofriendly but also economically viable.

MITES INFESTING FLOWERS AND THEIR MANAGEMENT

P. K. Sarkar

Preamble :

Mites aren't insects, they're arachnids; the same class as spiders. Several mites attack polyhouse and field floriculture crops. Economically important groups include: two-spotted spider mites, Red mite, Bulb mites, Yellow mites, and false spider mites. Flowers like Rose, Marigold, Gerbera (Indigenous and High breed), Geranium, Balsam, Chrysanthemum, Carnation, Dahlia, Petunia etc. are highly susceptible to mite attack in the Gangetic Alluvial plains of West Bengal initiating from last fortnight of January with increase in ambient temperature.

Yellow Mite: *Polyphagotarsonemus latus* :

These mites are tiny less than 0.3 mm long. Colorless or opaque white and waxy looking, they have four pairs of legs, The fourth pair of the female is slender with a long, hair extending from the tip. The fourth pair of legs of the males ends in a strong claw. Broad mite eggs are elliptical, translucent, colorless. The young mites (larvae) are about 0.2 mm long, whitish and have three pairs of legs. The legs have microscopic claws and suction cups. The quiescent Stage appears as an immobile, engorged larva. Broad mites attack a wide range of commercially important plants, including gerbera, African violets, cyclamen, begonias, impatiens, verbena and gloxinia. Broad mite damage is usually expressed as distorted and downward curling leaves resulting from a toxin secreted by the feeding mites. As well, internodes and petioles of flowers become shortened, and flowers may fail to open. Severely infested plants become stunted and die.

Two-spotted Spider Mites, *Tetranychus urticae* :

Almost all broad-leafed plants are susceptible to attack by two-spotted mites. They are known to attack over 300 plant species and thrive under greenhouse conditions. The adult reproductive stage is greenish with two dark feeding spots on the back and is about 0.5 mm long. Female lays an average of 100 eggs. The round, pearly white eggs are too small to be seen with the unaided eye. The newly hatched individual goes through a larval and two nymphal stages before becoming adults. Time from egg to adult is dependent mainly on temperature. Numbers build up quickly under hot, dry conditions when it can take as little as 8 days at temperatures of 25 to 35°C. Eggs are laid on the under surfaces of leaves and all stages feed there. These mites prefer young, tender leaves where they suck out plant juices. A chlorotic spot or stippple develops at each feeding site as chloroplasts are sucked out along with the plant sap. Leaves eventually develop a mottled appearance. Severe infestations can result in leaves becoming brittle and parchment-like. Foliage can drop off and plant death may occur. As numbers build-up, mites form webs of fine silk on plant terminals leading to further aesthetic injury. There is some evidence that even low levels of mite feeding causes plant stomatal closure, resulting in decreased CO_2 uptake and reduced transpiration and photosynthesis.

Red Mite: *Eotetranychus sp :*

It is primarily a pest of poinsettia, Dianthus, Carnation, Hollyhock, Verbena etc. They are similar in appearance to two-spotted mites, but are slightly smaller and have several small spots, rather than two large spots, when viewed under a microscope. The damage they inflict on crops is similar to that of two-spotted spider mites. They feed on the undersurfaces of leaves, piercing the epidermis and removing cell contents. This results in a stippled appearance on the upper leaf surface. Eventually the entire leaf becomes bleached and falls off. Heavy infestations will produce webbing, but not as extensive as that of two-spotted spider mites.

Bulb Mites: *Rhyzoglyphus* sp :

Bulb mites are slow moving and relatively large, 0.5 to 0.9 mm long. They are pearly-white and smooth, with short reddish legs. Bulb mites have spread throughout the world presumably via shipments of infested bulbs. Bulb mites occur as large colonies, not as individuals. Females produce at least 100 eggs that are deposited near injured or decaying tissue.

Bulb mites are usually considered secondary pests of bulbs, but can be responsible for serious loses. They invade bulbs at points of mechanical injury and, once established, they spread rapidly and destroy large areas of the bulb. In addition to feeding damage, the mites provide access to fungal root pathogens, such as *Pythium, Rhizoctonia,* and *Fusarium.* Infested bulbs may rot or produce stunted, distorted, or off-colour plants. Host crops include dahlia, gladiolus, narcissus, orchid, and tulip.

False Spider Mite: *Brevipalpus* sp :

False spider mites or flat mites are flattened, very small, reddish, and slow moving. Adult false spider mites are about 0.3 mm long. The eggs are red, somewhat flattened, and take up to 3 weeks to hatch. The immature stages feed and develop for 5 to 6 weeks before becoming adults. The life cycle is about 5 times longer than the two-spotted mite life cycle. They attack a wide variety of ornamental plants, but are most commonly found on orchids.

They feed first along the midribs of leaves and then disperse outwards. They puncture the epidermis of the leaf and suck out the plant juices. This results in the leaves having first a mottled and later a silvery appearance. Under conditions of severe infestations, plant tissue turns brown and dies. Stems are also attacked. False spider mites do not produce webbing.

Management of Mites in Flowers :

- Sanitation is the first step in managing mites. Weeds are common host plants, (Wild taperi (*Physalis minima*), *Ludwigia parviflora, Cyanodon dactylon, Sonches arvensis, Chenopodium album, Oxalis corniculata, Chicorium intibus*) so, ensure that weeds inside and adjacent to polyhouse and fields are eliminated.
- New plants should be inspected for mites before planting them in fields.
- Do not have any "pet plants" (alternate host i.e. weeds) inside the field.
- Mites thrive on plants that are under stress. Be sure to keep plants watered, give them adequate light, and fertilize properly.
- Heavily infested plants should be discarded.

Take care that, Two-spotted spider mites breed rapidly, so the potential for resistance development is high. The primary method of minimizing the development of resistant mite populations is to avoid using the same miticide for more than three consecutive sprays. A tank-mixing pesticide with different modes of action is also thought to promote resistance. As mites are very small, relatively immobile, and occur mainly on leaf undersurfaces, so thorough spray coverage is essential for adequate control. Most pesticides will not kill the egg stage, so at least two applications are necessary. A spreader-sticker or wetting agent will improve the effectiveness of most miticide, particularly on waxy leafed plants. However, that may increase the possibility of phytotoxicity; do a test spray before doing any large-scale applications.

Why Resistant Management in Mite is Difficult?

Development of resistance in spider mite is very rapid; hence, effective management is difficult. Hot, dry weather may also favour to proliferate over their natural enemies. Under these condition mites may become a serious pest and miticide are to be used. Mechanism of mite resistance to acaricide is little understood.

Possible resistance management strategies (Indian scenario) :

Following key acaricides may be applied in sequence : Propergite-spiromesifen–abamectin-Profenophos-diafenthiuron-milbemectin. Maximum two/three applications per season : which must not be consecutive.

New approaches for controlling Mites :

Continuous development and research for novel compound affecting specific process such as CSI, JH mimics and Ecdysone agonists is going on through out the world to ensure green earth. Further, effort have been already been made to develop compound acting selectively on groups of mites/insects by inhibiting/ enhancing Bio-chemical sites : Respiration (diafenthiuron : Pegasus), METI (fenazaquin : Magister), GABA receptor (avamectin : Vertimec), Lipid bio-synthesis inhibitor (spiromesifen : oberon)

Acaricides recommended for safe use (bio-rational) are :

Profenophos (karina : 1.5ml/lt water), wettable sulphur (sulfex : 5 gm/lt water), Propergite (omite : 3–4 ml/lt), Fenazaquin (Magister : 1.0–1.5 ml/lt), Abamectin (Vertimec/ABC1.9: 0.75 ml/lt), Spiromesifen (Oberon 1 ml/lt), Fenpyroximate (Sedna 1–1.25 ml/lt).

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COMMON FLOWER DISEASES IN WEST BENGAL AND ITS MANAGEMENT

Jayanta Tarafdar and Sambit Dutta

Background :

Plants may suffer seriously due to biotic and abiotic stresses during its growth and development stages. For any biotic factor, pathogenic assault causes harmful alteration in plant morphology, physiology and metabolic processes which manifests to disease development. The plant diseases are caused by potential colonization by microbial pathogens and parasites. Several fungal, bacterial, viral pathogens infect plant tissues by overcoming existing complex defense system in plants. Flowering plants likewise crop plants get infected with several pathogenic organisms which cause tremendous loss of flower production during its cultivation, transit and storage as well as reduce the quality of the flower. Control of plant diseases caused by these pathogens can be achieved through proper management practices and by the use of antimicrobial compounds. Several fungal pathogens are capable of causing significant losses in the production of flowering in commercial plots, gardens, nurseries and potted plants.

Like other crops, presently flowers and ornamental plants are being exported to many countries from India. Cultivation of flowers became very popular in gangetic plans of West Bengal and is being commercially cultivated in many districts of this state. Among the commercially cultivated flowers, tube rose, rose, chrysanthemum, marigold, gladiolus, gerbera, dahlia etc. are very popular in West Bengal and are exported in many states as well as abroad. Besides these many winter and summer annuals like balsam, jasmine, sunflower, zinnia and foliages are commercially cultivated in many places. Presently many high value flowers like gerbera, carnation, orchids and other flowers are commercially cultivated under covered controlled conditions (poly green house) throughout the year. To meet the high demand of flowers, production of disease free healthy seedlings and seeds of popular varieties and exotic types became very popular in many nurseries. The intensive cultivation of flowers needs proper management practices employing advanced technologies for good quality, vibrant colored flower. Among the biotic factors diseases caused by the fungal pathogens, bacteria and viruses are the major limiting factors which pose significant loss of flower production and reduce the quality of flowers. Every garden/poly green house has a range of more or less permanent soil-borne disease organisms. Flower plants show aboveground symptoms of disease when it is infected by a pathogen organism. Damping-off disease, for example, can occur under moist conditions and the ideal conditions for this disease are favoured by overcrowded situation in nursery beds as well as in the main field. Soil-borne diseases in the garden include pre- and post-emergence damping-off (commonly *Fusarium, Pythium* and *Rhizoctonia* species), root rot (for example *Phytophthora*), vascular wilts (for example *Verticillium* and *Fusarium etc.*), and nematode diseases. As the seedling diseases are mainly soil borne in nature proper care should be taken in the nursery beds to get disease free plantlets or planting materials. There are a host of fungi associated with root rots of flowering plants. Nevertheless, four fungi, *Pythium, Phytophthora, Rhizoctonia, and Thielaviopsis*, are responsible for most of the damage to potted plants in greenhouse production. It is important to determine which of these fungi is responsible for the root rot, since cultural and chemical controls will vary for these organisms.

In the main field, several diseases may occur at every stage of the growth of the plants. The annual and perennial flowers may be infected by the leaf spots (black/brown), blight of leaves and flowers, mildews (powdery/downy), wilt of plants and other diseases which cause yellowing/browning of leaves, blighting plants, and wilt that cause eventual yellow or blighting of plants, then die. Although not fatal to plants, many diseases make the plants and flowers unattractive and may weaken plants over several years. The chrysanthemum, marigold, dahlia, tube rose, rose are seriously infected by leaf spots, blights and powdery mildew fungi which cause serious damage the flowers. Recently leaf spots and blight of tube rose and marigold became devastation in many commercial flower fields of West Bengal. The Diplodia leaf spot/black spot, powdery mildew, canker and Botrytis blight of rose are the major problem in rose cultivation. The twig blight of jasmine also became very widespread in hot summer.

Disease Management Strategies :

Cultural and physical methods to eliminate or reduce the diseases:

Practice Hygiene :

- Plant material (cuttings, transplants, and seeds) should be purchased from a reliable source and care should be taken to avoid seedling infection in nursery beds who commercially produce the flower seedlings.
- Second-hand tools or garden machinery should be sterilized before being used in your garden. Potting containers (reusing pots) are needed to be sterilized before plants are seeded. Use 10% sodium hypo chloride (1 part bleach to 9 parts water). Soak pots 10 to 30 minutes. Some reports indicate pots should be rinsed and dried before using. Sodium hypochlorite is corrosive to metal parts. Avoid long-term soaking of pruning equipment, etc.

- Use good quality potting mix (avoid using un-decomposed compost materials)
- Dispose of diseased plant material by burning or composting. Do not use the raw infected/plant material for mulching. Use straw or polythene much for better results.
- Maintain plants in a healthy state. Avoid excessive nitrogen fertilization and over fertilization/irrigation to reduce root rot and other diseases.
- Watering should be given in the morning (must be completed within 9-9.30 O'clock)
- During land preparation (main field) amendment of good quality organics with proper doses is necessary and light irrigation may be given at least two to three days before planting in hot summer days (avoid planting of seedlings followed by irrigation immediate after application of compost/ manures because irrigation in amended soil increases the soil temperature that damage the seedlings).
- Provide good drainage to avoid water logging which may cause root injury and subsequent root infection.

Use of Biocontrol Agents to Suppress the Soil Borne Pathogens :

In addition of composts/manures several biocontrol agents are now available which could be incorporate or mixed with the organics to reduce the root rot/ wilt pathogens of flower plants as well as reduce the inoculums load of some pathogens. Application of organics and biocontrol agents mix also improve the physical structure of soil and work as soil conditioner that helps to reducing many root/stem rot diseases and improve the health of flower plants.

Several fungal and bacterial antagonists like *Trichoderma viridis*, *T. harzearum*, *Bacillus subtilus*, *Chaetomium globosum* etc. are the potential biocontrol agents when added to potting mixes or incorporate in the soils in poly house or in the main field have been reported to reduce the severity of certain root rots. These products are less effective when applied after the disease has developed.

Fungicides are an important tool in managing root rot diseases when used in conjunction with cultural management practices. Fungicides rarely, if ever, eradicate fungal pathogens; they merely suppress disease development for a certain period of time. If conditions for fungal infection are favorable after this period, the disease may once again progress. Therefore, try to maintain environmental conditions that are favorable for plant growth but unfavorable for fungal development.

Application of Plant Protection Chemicals (Fungicides/Antibiotics) :

Finally, use fungicides are the only way to protect healthy plants from becoming infected when other, infected plants are in close proximity. Fungicides are generally protective type and few fungicides are actually curative and will protect new foliage from becoming infected. Fungicides tend to be more effective when applied before or as soon as symptoms are apparent. Routine application of preventive fungicides such as Mancozeb, Carbendazim with recommended doses could be done in drench program.

Several fungicides are labeled for control of root rot pathogens, leaf and flower infection. But single fungicide will not effectively control all root rot pathogens and damping off diseases of seedlings. Many formulations of combination of two products are currently labeled which give broad spectrum protection against several diseases of flower plants. Individual fungicides may be mixed before application or purchased commercially premixed. Among the combination products- Metalaxyl + Mancozeb 72WP, Metalaxyl-M+Mancozeb 68WP, Cymoxanil+ Mancozeb 72WP, Carbendazim+ Mancozeb 75WP, Zineb+ Hexaconazole 72WP are available in the market which give excellent control of damping off disease of flower seedlings and some blights of plants in most of the flower plants. Other fungicides like Difenconazole 25 EC, Chlorothalonil 75WP, Strobilurin fungicides (Azoxystrobin 23SC, Pyrachlorostrobin 20 WG etc.), Dimethomorph 50WP, Dinocap 48EC could be used safely in most of the flower plants without causing any injury in flowers. It is noted that misapplied pesticides (over dose, tank mixure of incompatible fungicides and antibiotic) can cause injury to the plants that can sometimes be confused with virus diseases. The selection of right fungicides in the flower bearing plants is very important as the wettable powder formulation or dust may produce spots and undesirable deposition on the flower petals that reduce the market quality of flowers. The leaf spot and blight of marigold could be effectively controlled by application of Difenconazole 25 EC @0.5-0.75ml/L of water. The leaf spot and flower rot are very common in tube rose and seriously reduce the flower production. Protective spraying of Mancozeb 75WP, Chlorothalonil 75WP @ 2.5gm and 2.0gm/L of water respectively could reduce the disease; these fungicides could be alternatively used with Azoxystrobin 23SC @ 0.75-1.0ml/ L of water which keeps the plant green for longer times. Metalaxyl + Mancozeb 72WP, Metalaxyl-M+Mancozeb 68WP, Cymoxanil+ Mancozeb 72WP, 2-3gm/ L of water may be applied to control twig blight and leaf blight of jasmine, balsam, vinca caused by *Phytophthora spp.*, Botrytis rot of rose and other annual flowers; but any of these fungicides could not be used repeatedly. Alternate use of Metalaxyl+Mancozeb 72WP or Metalaxyl-M+Mancozeb 68WP or Cymoxanil+Mancozeb 72WP with other single contact fungicide/ mixed may be used to avoid pathogen resistance against the Metalaxyl/ Cymoxanil. Single application as soil drench with mix fungicides Metalaxyl-

M and Chlorothalonil is very effective to control the damping off of flower seedlings as well as in poly house application. This fungicide could be used at two-four leaves stage of the seedlings which controls the damping off as induces the seedling vigor.

Carbendazim 50WP is extensively used and very effective fungicide for controlling wilt and some leaf diseases and generally applied @ 2.0gm/L of water as foliar spray or soil drenching. The mix formulation of Carbendazim + Mancozeb 75WP is very popular for controlling many foliar and root infecting pathogens in flower plants which also induce biochemical defense system in the plants.

It has been reported that it is important not to plant the same crop in the same location season after season. Sometimes this is difficult due to limited space but breaking up the crop cycle and planting something different or leaving the greenhouse empty for a brief period in conjunction with good sanitation practices can prevent the build-up of disease organisms.

Foliar symptoms may include light green/yellow mottling, yellow spots or light-colored concentric rings. Viruses can be seed-borne or vegetative propagated materials or transmitted via insects or contaminated garden tools. There is no chemical control for viruses. If the diseased plants are noticed in the field, removal and burning of infected plants are particularly essential in the case of viruses as there is no cure once a plant is infected with a virus. However, control of insect vectors with proper insecticides/biocides is necessary to check the spread of the diseases. Some of the important diseases & their management are shown below:

POWDERY MILDEW

- Causal Org.: *Sphaerotheca species*
- Powdery growth on leaves
- Distorted leaves
- Cure: Myclobutanil, Dodaine, Hexaconazole

BLIGHT (*Botrytis cinerea*)

- Buds fail to open; covered with grey mould
- Discoloured stems
- Moist air; cool temperature
- Destroy infected parts; Carbendazim spray

BLACK SPOT (*Diplocarpon rosae*)

- Circular spot on the upper surface of the leaf
- Spots coalesce and leaves dry

- Prune infected parts and apply copper hydroxide paste
- Carbendazim; Chlorothalonil

APHIDS :

Curling of leaves, foliage withered and become distorted, exudes honey dew like substances that attract ants.

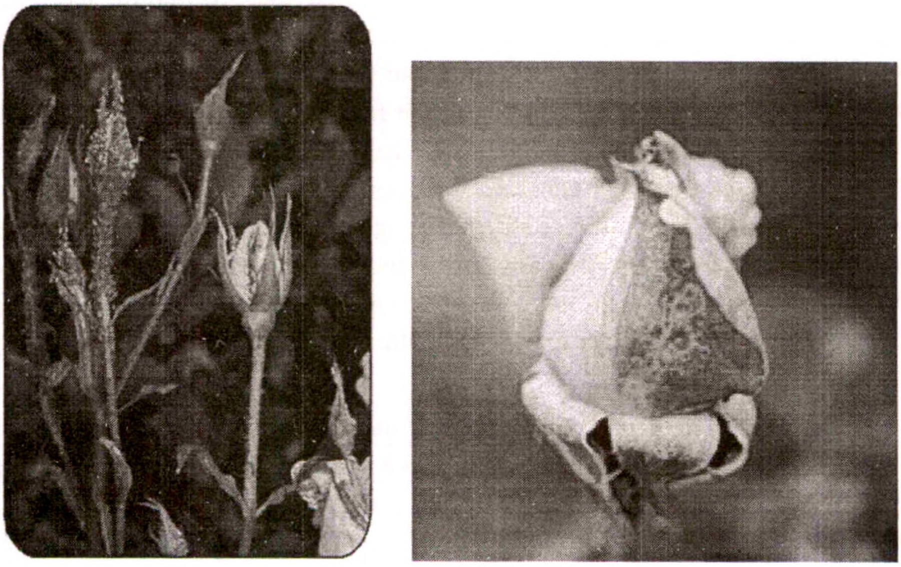
Control : Spray with Dimithoate, Immidachloprid, Thiomethoxam etc.

THRIPES :

- Deformed flowers
- Petals have brownish streaks
- White roses most affected
- Acephate (0.75 g/l); Thiachloprid (3g/15 lit) Thiamethoxam (1g/l)

MITES

- Suck sap from the lower surface of the leaf and sometime flower.
- Webbing of leaf.
- Rotational sprays of Propargite (1 ml/l), Dicofol (1 ml/l), Flufenoxyuron (1 ml/l), Milbemectin (1 ml/l).



Flower thrips damage to rose

INTEGRATED NUTRIENT MANAGEMENT FOR FLOWER FOLIAGES

Niharendu Saha and Biswapati Mandal

Preamble :

Indian floriculture and its downstream flower industry have been gaining momentum recently due to globalization of market and subsequent initiation by the Government. India is endowed with all sorts of climate required for flower cultivation. But most of the exotic flowers those fetch foreign exchange are cultivated in the highly intensified agricultural soils. Inclusion of flower crops in the existing cropping systems creates problem related to soil deterioration. Such intensification of agriculture has its attendant problems of salinization, acidification, desertification, nutrient depletion, loss of soil biodiversity, soil erosion etc. In some cases, year round cultivation of flowers with indiscriminating use of fertilizer, hormones and growth regulators, soils have become lifeless losing retentivity for nutrients as well as water. Besides, use of enormous fertilizer inputs substantially enhanced the production cost, deteriorates soil and water quality and increased the greenhouse gas effect making the production system unsustainable. More so, the quality of the flower and foliages in terms of vase-life and colour formation etc. are in questions. It has also been implicated in over-taking the resilience of agricultural soils and those natural processes that maintains its health and quality. Sometimes the stress exceeds the resilience capacity of the soil so that restoration becomes very expensive or even impossible. Since, the long-term performance of agricultural system is important for poverty alleviation and sustaining production in the face of continuous population growth, we need to redo our present way of cultivation with only inorganic fertilizer to save the natural resource base, particularly soil, for posterity.

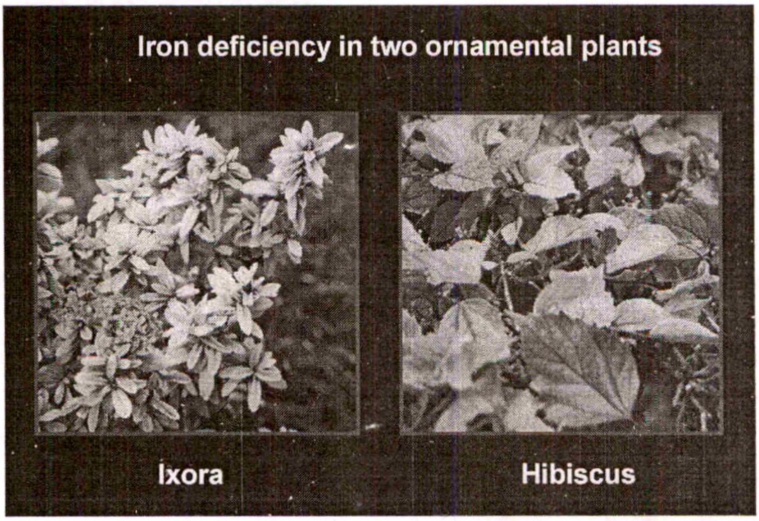
When these environmental problems in intensive agriculture came into spotlight, organic farming was advocated as a solution for most of the problems encountered. However, the organic farming is not only a very low yielder but has many of the problems of conventional high intensive agriculture. Thus organic farming methods do not offer solution to many of the problems. To achieve sustainability in production system and maintain natural resource base in good stead, blending or integrating organic, inorganic, biological and mechanical inputs with ecological principles in mind may be an option. Through this article an attempt has been made to discuss some of the issues involved in integrated nutrient management for flowers.

Nutrient Requirement of Flower and Foliage Crops

Flowers are going to constitute one of the components in current cropping system under both irrigated and non-irrigated areas. Because of high return, sometimes farmers also grow exclusively flowers on their land year the round. This has become more common after the introduction of excellent exotic cultivars for different flowers like gladiolus, marigold, tuberose etc. On biomass yield potentiality, they out-yield cereals and other commonly grown crops by many times. As such the major field-based flower crops remove no less amounts of N, P and K than other major crops. They severely exhausted the inherent nutrient sink to support crops on sustainable basis. More over, flower are cultivated in closed system, in nursery and also in household scale. Ornamental crops, particularly, flower and foliages are very much sensitive towards their choice of nutrients. Less attention has been given to the aspect of nutrient management of flower cultivation. Hence, greater emphasis needs to be given to check the depletion of nutrients from soils when flowers are grown alone or in a cropping system by maintaining adequate and crop specific nutrient supply and better soil environment.

Nutrient Imbalance and associated Symptoms in Flowers and Foliages :

Although flowers require and remove good amount of nutrients from soil, knowledge about the scientific management of the nutrients and formulation of fertilizer schedule for major cultivated flowers and foliages are lacking. This leads to imbalanced nutrition of those crops on one hand and wastage of costly fertilizer materials on the other. Imbalanced nutrition sometimes results in a net loss in value addition in flower cultication. This sometimes creates problem in global market Nutrient imbalances in flower crops visualize various forms of deficiency symptoms and encourage susceptibility to incidence of pest and diseases. To overcome this, a balanced nutrition using organic and inorganic sources of nutrients is essential. If done properly, this may also ensure not only a higher yield and less loss of costly fertilizer inputs but also maintain a good soil and ecosystem health for sustaining soil productivity.

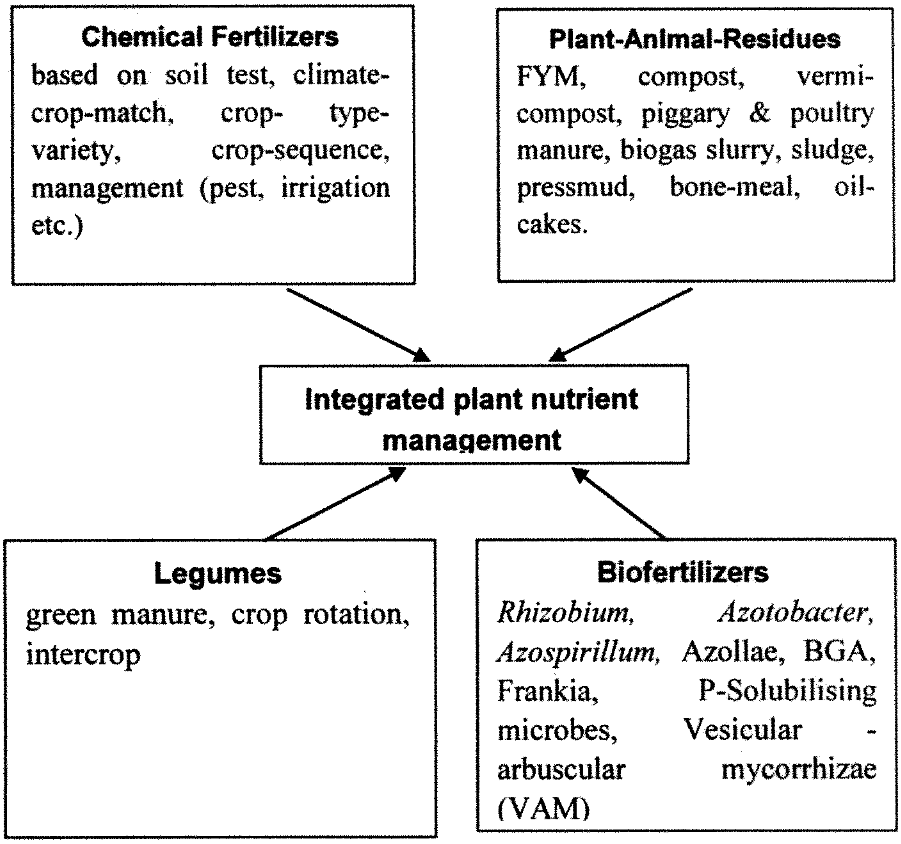


Some common deficiency symptoms associated with imbalanced nutrition

Symptom	Due to	Remedy
Leaves turn yellow or become necrotic and drop off	N deficiency	Soil application of N-ous fertilizer (ammonium and urea less than 50%)
Stunted growth, old leaves initially dark green, older leaves turn purple	P deficiency	Application of P and amelioration of pH
Leaf margin turn chlrotic and necrotic	K deficiency	Application of K in proportionately higher amounts
Uniform chlrosis fist on new leaves appearing	S deficiency	Apply S through elemental S or iron pyrites
Interveinal chlorosis of new leaves, bleaching of newer leaver	Deficiency of Fe	Soil application sulfates of iron @ 20 kg.ha^{-1} with basal NPK
Interveinal chlorosis of new leaves with some green next to vein, short internode, small leaves	Deficiency of Zn	Soil application of sulfates of zinc (20 kg/ha)
Interveinal chlorosis of new leaves and later with grey necrotic	Deficiency of Mn	Soil application $MnSO_4$ @ 25 kg.ha^{-1}
Interveinal chlorosis of new leaves with tips and edges green followed by veinal chlorosis	Deficiency of Cu	Soil application of $CuSO_4$ @ 20 kg.ha^{-1} with basal NPK

Proper management of plant nutrients is necessary to ensure higher productivity, balanced nutrition and for checking wastage of costly fertilizer nutrients as well. Above all the quality of flower will be ensured. The basic concept underlying the integrated nutrient management system (INM), nevertheless, is the maintenance and possible improvement of soil fertility for sustained crop productivity on long-term basis and also to reduce fertilizer input cost and environmental degradation by employing all possibly available, accessible and affordable sources of nutrients.

A delineation of INM components

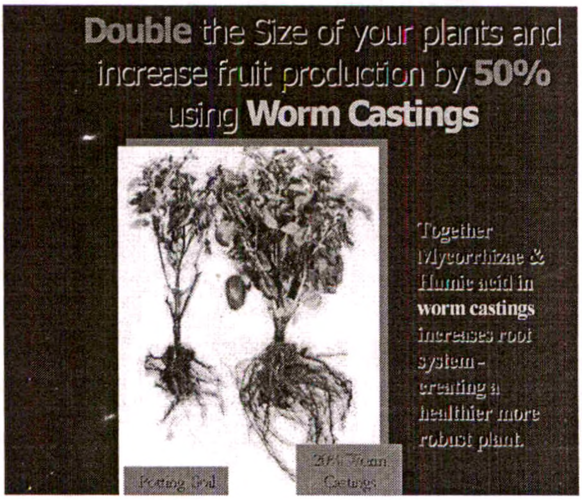

Chemical Fertilizers
based on soil test, climate-crop-match, crop-type-variety, crop-sequence, management (pest, irrigation etc.)
Plant-Animal-Residues
FYM, compost, vermi-compost, piggary & poultry manure, biogas slurry, sludge, pressmud, bone-meal, oil-cakes.
Integrated plant nutrient management
Legumes
green manure, crop rotation, intercrop
Biofertilizers
Rhizobium, Azotobacter, Azospirillum, Azollae, BGA, Frankia, P-Solubilising microbes, Vesicular - arbuscular mycorrhizae (VAM)

The judicious combination of organic and inorganic resources for balanced plant nutrient management is necessary since neither inorganic fertilizer nor the organic matter alone can bridge the gap between sustaining productivity and up-keeping soil health and resilience. The organic components are indispensable in—

- improving nutrient-use-efficiency,
- improving soil aggregation, aeration and water-holding capacity,

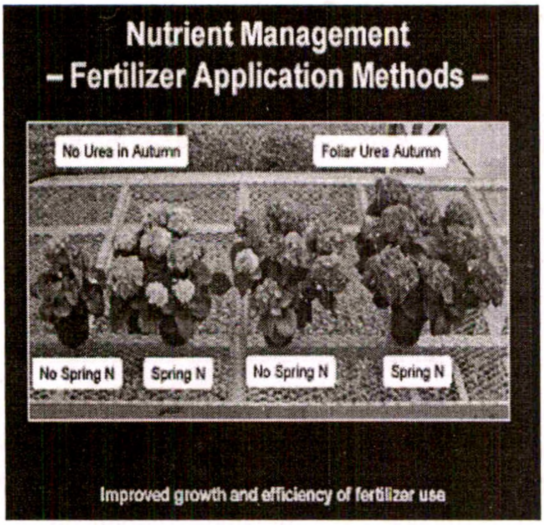
- preventing erosion,
- encouraging microbial population vis-à-vis activity,
- accentuating nutrient mineralization, and
- amending problems like soil acidity, salinity etc.

Nevertheless such priority roles organic components play in plant nutrient management, it alone can not make the orchestra. Organic matters are generally bulky in nature and difficult to port. The availability of plant nutrient is relatively slow and cannot be managed to administer in time/crop growth-stage wise schedule. The combination of organic and inorganic sources of nutrients may be an option to overcome the problems associated with each of the sources when applied alone.



Double the Size of your plants and increase fruit production by **50%** using **Worm Castings**

Together Mycorrhizae & Humic acid in **worm castings** increases root system - creating a healthier more robust plant.



Nutrient Management
– Fertilizer Application Methods –

Improved growth and efficiency of fertilizer use

Cultivation of flower and other ornamental crops are increasing day by day. Simultaneously the use of organic manures are also increasing. If the amount of chemical fertilizers used in flower cultivation is to be completely substituted by organic manures an astronomical figures of organic manure will be required rather impossible. Hence, for partial fulfillment and sustainable production, whatever organics are available, accessible and affordable by the farmer they must be returned to the soils along with the inorganic source of nutrients.

Chemical Fertilizer :

For normal and healthy growth, crop requires balanced supply of primary, secondary and micronutrients. The fertility status of soils and deficiency/ sufficiency levels of different plant nutrients will be evaluated on the basis of soil test results and recommendation for fertilizer application will be made accordingly. Special attention should be paid on tissue test for flower and foliages because in some cases higher soil test value does not manifest ib the leaf colour and growth of flower plants. This if mostly due to unavailability of that particular nutrient element. This phenomenon is primarily observed in micronutrient elements. However, application of huge amount of chemical fertilizer, particularly to meet the high nutritional demand of exotic cultivars of flowers, may end up with soil supporting low biological activity, acidified and imbalanced availability of different nutrient elements. Moreover, the improper form of nutrient application may results in weakening of flower stalk, lodging of plants, unsatisfactory colour formation in foliages.

Guidelines for Foliar Analysis Values (Based on Dry Weights) for Chrysanthemums.

Recommended Nutrient Concentration

N (%)	4.00 to 6.50
P (%)	0.25 to 1.00
K (%)	3.5 to 6.5
Ca (%)	0.50 to 2.00
Mg (%)	0.3 to 0.6
B (ppm)	25 to 100
Cu (ppm)	5 to 50
Fe (ppm)	50 to 300
Mn (ppm)	30 to 350
Zn (ppm)	15 to 50

Rating Chart for Soil Test Data :

Fertility level	Organic carbon Percent	Available N(kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
High	> 0.75	> 450	> 90	> 340
Medium	0.50-0.75	280-450	45-90	150-340
Low	< 0.50	< 280	< 45	< 150

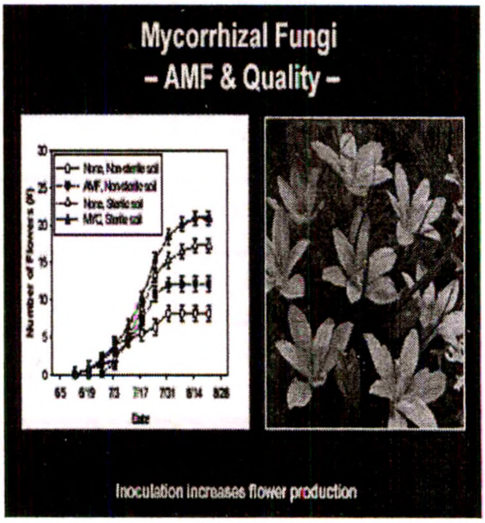
Soil Status and Fertilizer Guide for Secondary and Micronutrients :

Micro/Secondary Nutrients	**Critical limit (mg/g)**	**Fertilizer recommendation**
Zinc	0.6-1.0	$ZnSo_4$ @ 25 $kg.ha^{-1}$ with organic manure
Boron	0.5	Borax @ 10 $kg.ha^{-1}$ with basal NPK
Molybdenum	0.2	Ammonium molybdate @ 1.0 $kg.ha^{-1}$ with basal NPK
Iron	2.5-4.5	$FeSO_4$ @ 50 $kg.ha^{-1}$ with organic manure
Manganese	1.0	$MnSO_4$ @ 30 $kg.ha^{-1}$ with basal NPK
Copper	0.2	$CuSO_4$ @ 5 $kg.ha^{-1}$ with basal NPK
Sulphur	10-12	Elemental S @ 25-45 $kg.ha^{-1}$

(Source: Dir. Of Agriculture, Govt. of West Bengal)

Organic resources :

The huge nutritional demand of flowers, in general, is difficult to meet through organic sources of nutrients. Neither it is practical to restrict nutrient management through organics. However, in many occasions it is found that combined application of mineral and organic sources have synergistic effects for increasing the fertilizer-use-efficiency of crops. The organic improves soil physical condition by improving soil aggregation, aeration and water-holding capacity of the soil and prevents erosion. Application of organic sources also triggers



Mycorrhizal Fungi
– AMF & Quality –

Inoculation increases flower production

microbial activities, which directly reflects on the transformation of nutrient to easily available form (mineralization). All this inter alias, help to have higher use efficiency of fertilizer vis-à-vis native soil nutrients by the standing crops. This synergistic effects of organic and inorganic sources of nutrients may be utilized for harvesting good quality of flowers.

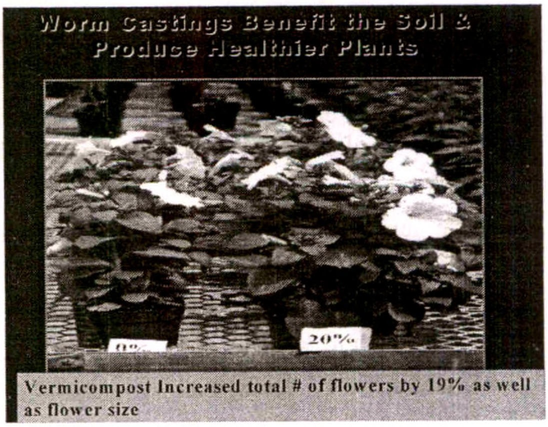
Mineral Values of Some Commonly used Organic Sources :

Organic manure	**Nutrient Content (%)**		
	N	**$P_2 O_5$**	**K_20**
FYM	0.5-1.0	0.3-0.5	0.4-1.0
Compost (urban)	1.2-2.0	1.0	1.5
Compost (rural)	0.4-0.8	0.3-0.6	0.7-1.0
Slurry from gobar gas plant	16- 1.8	1.1-2.0	0.8-1.2
Dhaincha (green manure)	0.6	-	-
Cowpea (green manure)	0.7	0.1	0.6
Mustard Cake	5.1	1.8	1 .1
Neem Cake	5.2	1.0	1.4
Groundnut Cake	7.0	1.5	1-3
Linseed Cake	5.5	1.4	1.2
Mahua Cake	2.5	0.8	1.8
Castor Cake	5.5	1.9	1.0
Sludge	2.5	1.0	0.4
Activated Sludge	4.0- 7.0	2.1-4.2	0.5-0.7
Vermi Compost	1.0	0.5	1.5

(Source: Dir. of Agriculture, Govt. of West Bengal)

Biofertilizers :

Biofertilizers are the cultures of microorganisms used for inoculating seed and soil or both under ideal condition to increase the availability of plant nutrients. They are cost-effective, eco-friendly and renewable sources of plant nutrients used to supplement chemical fertilizers in



Vermicompost Increased total # of flowers by 19% as well as flower size sustainable production system. Some common biofertilizers of agricultural importance for flower cultivation are Azotobactor, P-solubilizer and VAM. The N-fixers like Azotobacter, Azospirillum, P-solubilizers and VAM are commonly used to flower crops like gladiolus through corm inoculation (@ 2.5 kg biofertilizer dissolved in20L water with starch/molasses for one hectare), seedling root soaking (@ 2.5 kg fertilizer dissolved in 35-40 litre of water for 30 mins soaking seedlings of one hectare) and soil application (@ 4.0 kg fertilizer+200-250 kg organic manure for one hectare during land preparation).

The Development of a Comprehensive Farm Plan for Nutrient Management on Nursery and Floriculture Crops Involves a Set of Ten Management Goals :

- Evaluate current irrigation and fertilization practices and plan improvements in management.
- Avoid fertilizer material spills during all phases of transport, storage, and application.
- Conduct efficient fertilizer practices for plants grown in. Follow efficient fertilizer practices for hydroponically grown plants.
- Evaluate the substrate or soil that crops are grown in to optimize root growth.
- Operate irrigation systems to minimize nutrient losses, especially N.
- Operate irrigation systems to improve irrigation efficiency.
- Improve the uniformity of existing drip irrigation systems.
- Improve the uniformity of existing sprinkler irrigation systems.
- Evaluate and maintain nutrient management goals and management practices.

Some Important Information for Flower Growers:

- **Fe** deficiency is the most common deficiency problem on flowering and foliage plants
- Fe and Mn deficiencies are due to high pH
- For flowering trees, micronutrients can be injected
- Foliar application must be restricted during hot summer months
- Maintain low level of N
- Use less than 50% N as ammonical and urea fertilizer and it must be maintained in soil less culture
- If the leaf blade is not normal green in case of foliage plants N and micronutrient are needed
- Unsatisfactory foliage color indicates low O2 level due to inadequate drainage or excess water

- Assure water quality
- Limestone should not be used in commercial growing medium for pH correction
- Liquid feeding should be followed
- Chelated micronutrient are suitable
- Elemental S and iron pyrites are better choice for pH amelioration
- Toxicity of any element can be corrected by immediate withdrawal of fertilizer or changing media pH or use of antagonism
- Fe, Zn, Mn, Cu, B, Cl, and Ca deficiency symptoms occur in new leaves
- N, P, K and Mg deficiency symptoms occur in older leaves
- Mo deficiency symptoms occur in between new leaves and old leaves
- In potted plants Mo deficiency is not common except Poinsettia

Conclusion :

Flower business is an upcoming non-conventional global business. With the increasing demand both in domestic as well as foreign market, its status in Indian economy also gaining escalation. But undoubtedly, it faces some serious problems associated with quality product and competitive market price, particularly in global market. With the rapid emergence of African countries in global market with lower flower price, Indian flower industry is now in challenging condition. So, it is imperative to initiate technological intervention to lower down the cost of production in one hand and improvisation of flower quality in other hand. Nutrient integration is an appropriate technology that can bridge the both end and can help the industry to survive.

TROPICAL ORCHIDS : A BETTER OPTION FOR PRODUCTION

Tapas Mandal

Introduction

Orchid wealth: Orchids form about nine per cent of our flora. Nearly 1300 species of orchids, spread over 140 genera, are reported from our country (Arora, 1986).

The distribution of orchid species in different regions of India is as follows :

♦ North Western Himalayas	200
♦ North Eastern India	800
♦ Western Ghats	200
♦ Others	100
♦ Total	1300

Orchids :

- The word **orchid** from the term *orchis*, means testis, may be traced back to a pupil of Plato and Aristotle.
- Theophrastus (370-285 B.C.) called the 'Father of Orchidology'. He first used The Greek term *orchis*, referring to the paired underground bulbs of the mediterranean orchid plants.
- It was finally retained and adopted by Linnaeus in his *Species Plantarum* (1753).

Indian Floriculture : Possibilities

- A consistent increase of 10-15% jump in the flower trade in the last few years and this is largely due to the adoption of modern technologies.
- India has approximately 350 ha under greenhouse cultivation with a export value of Rs. 220 crores during 2003-04.
- India is one of the potential countries for flower production because of favourable climate, availability of human resources and its strategic geographical location nearer to international markets.
- The major cut flowers in international markets are rose, chrysanthemum, tulip, carnation, lily, gerbera, freesia, *Cymbidium*, *Alstroemeria* and *Limonium*.
- For many years *Cymbidium* (an important genus of orchids) remains in the list of top ten cut flowers.

West Bengal :

West Bengal is a treasure house of orchids. The northern hilly parts of the state namely Kalimpong, Darjeeling and Kurseong are the major habitats of lion's share of subtropical and temperate orchids. Business oriented production is also confined to these areas.

- Some tropical species are found in the southern part of West Bengal but these are not grown commercially in spite of having possibilities to grow them.
- Tropical hybrid varieties with wider acceptability in markets may perform satisfactorily under protected condition in the plains of southern Bengal.
- Covered cultivation under appropriate structure and management may also be cost effective for production of good quality flowers.

Orchids in Trade :

Among the orchids, *Cymbidium* cut flowers rank first and in all floricultural crops, it ranks eighth and accounts for 2.7% of the total cut flower production. In India, almost all *Cymbidium* cut flowers are marketed from northeastern hills specially Darjeeling and Kalimpong areas of West Bengal. *Dendrobium* accounts for over 85% of the tropical cut flower trade.

Thailand is the largest producer of tropical *Dendrobium*, *Vanda* etc. Asian countries like Sri Lanka and Singapore also produce a wide range of tropical orchids. In The Netherlands, *Dendrobium* flower market is dominated by Thailand. USA, the European Union, Germany, UK and France import *Dendrobium* mainly from tropical countries. Countries like Thailand, Singapore, Malaysia, Indonesia, Japan and Australia are growing orchids commercially.

Economics :

Orchid cut flower and plant production may develop into a cottage industry on individual or co-operative basis. A net profit of Rs. 6000/month on average is expected after deducting the initial costs of investment (excluding land) from area of 100 m^2 with 1750 plants in pots under shade-house projected over 6 years.

Inter Generic Hybrids :

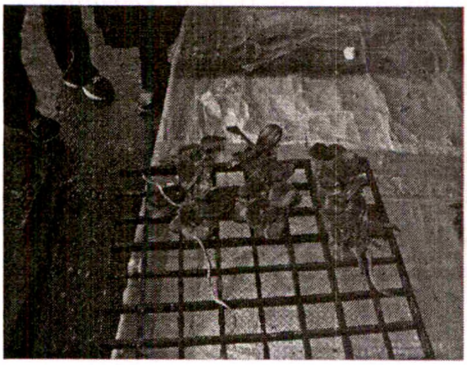
Bi-Generic Hybrids

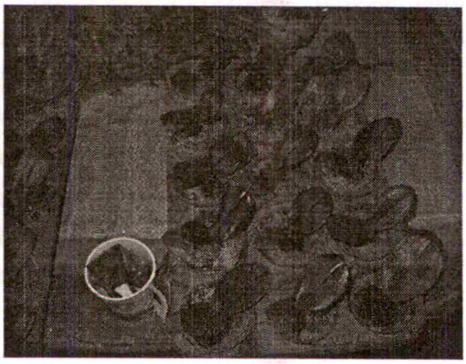
- Aranda (*Arachnis* × *Vanda*) eg. Christine, Peter Ewart, Mandai Prince etc.
- Aranthera (*Arachnis* × *Renanthera*) eg. Annie Black, Mohammed Hanif,
- Ascocenda (*Ascocentrum* × *Vanda*) eg. Mani beauty, Wanpen

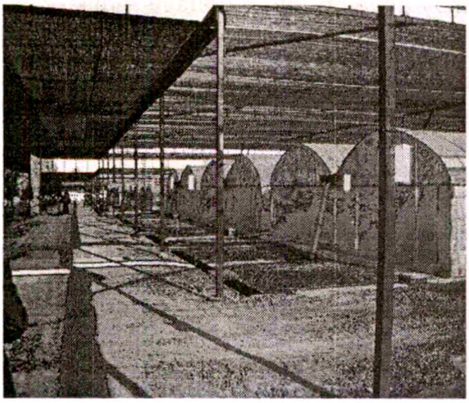
Tri-Generic Hybrids

- Mokara (*Ascocentrum* × *Vanda* × (*Arachnis*)

Bangkok: White moss as Media



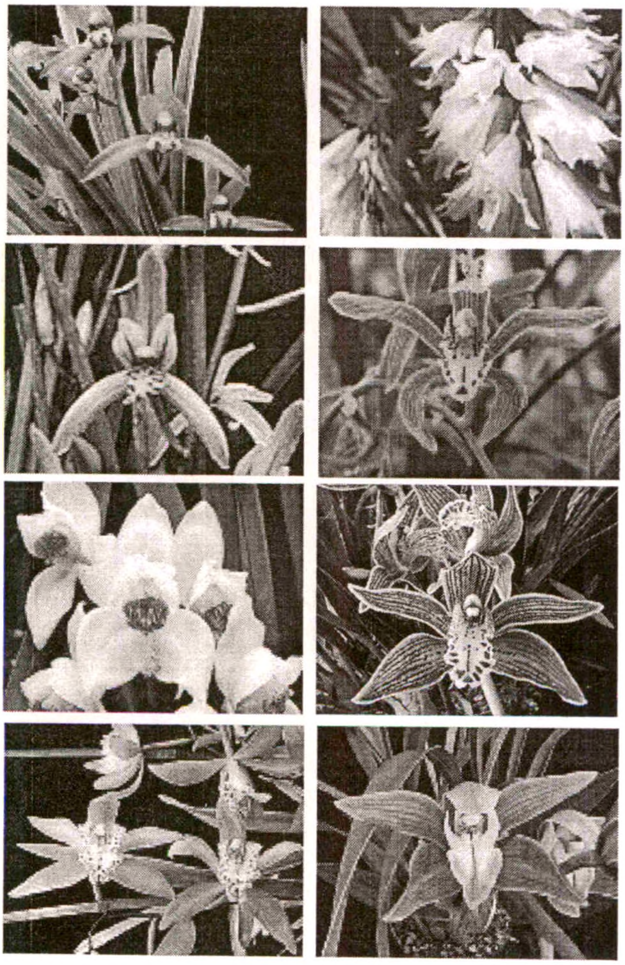




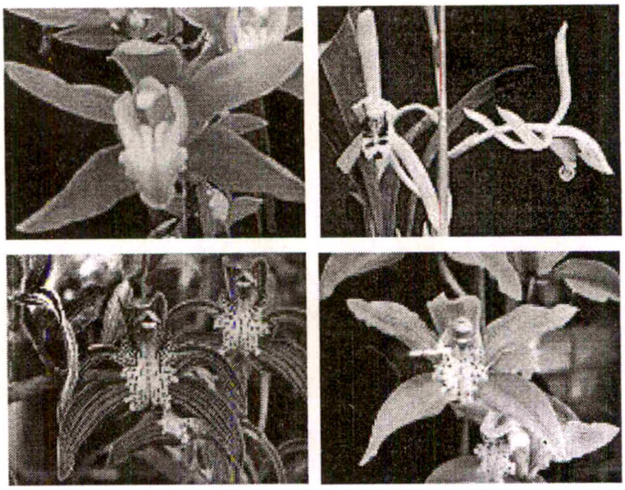
Plantation of Orchids in Green House

Cymbidium

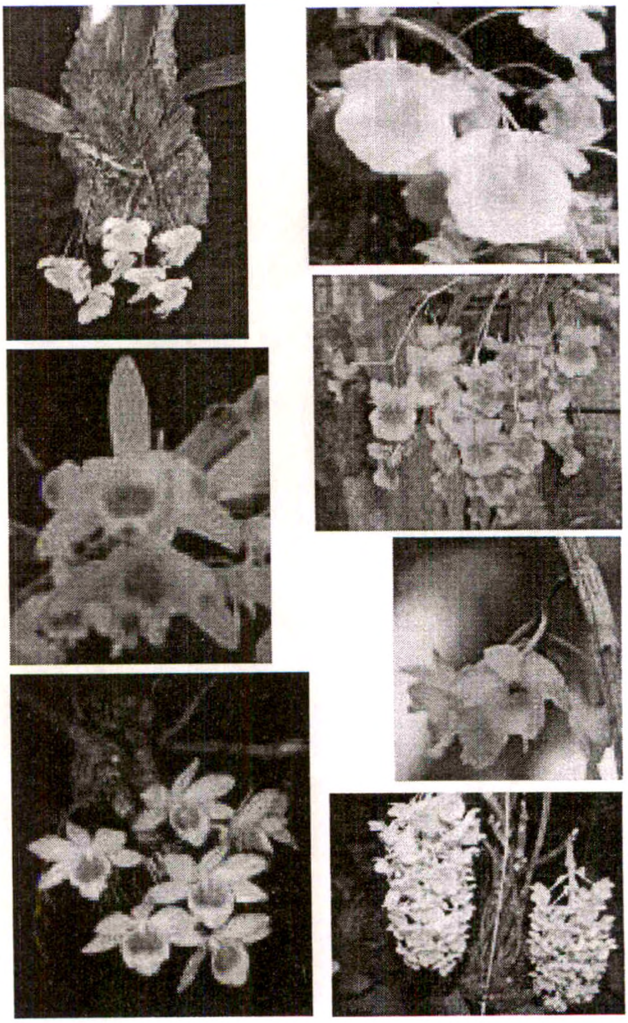
- ***Cymbidium cyperifolium***
- ***C. elegans***
- ***C. ensifolium***
- ***C. erythraeum***
- ***C. erythrostylum***
- ***C. giganteum***
- ***C. hookerianum***
- ***C. jansonii***



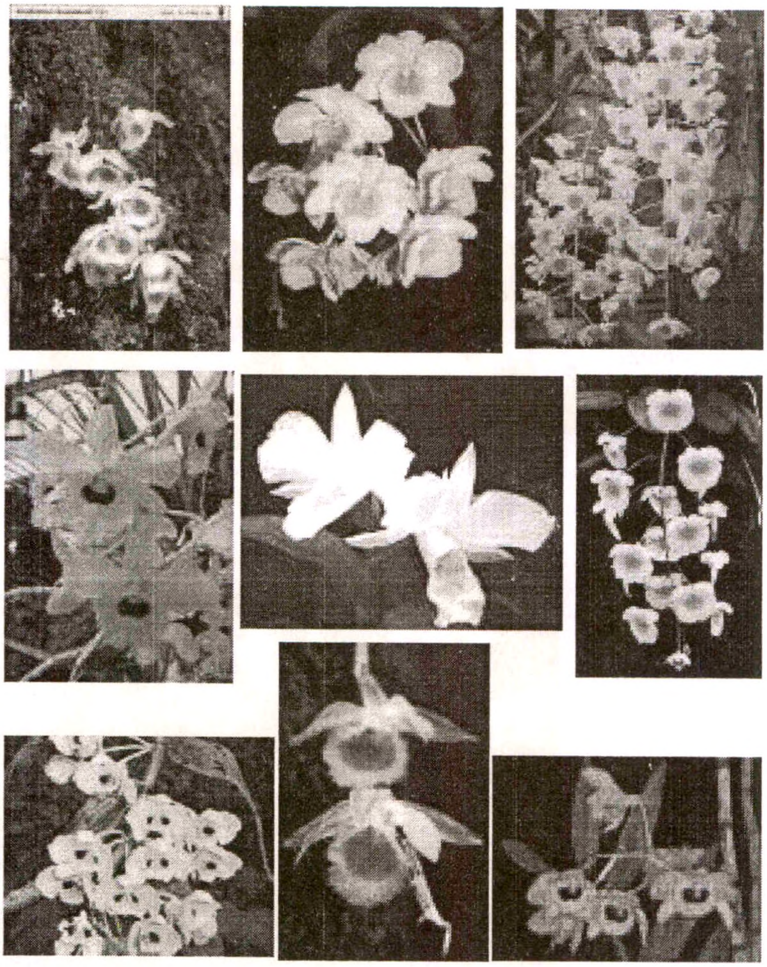
- *C. lowianum*
- *C. lancifolium*
- *C. tracyanum*
- *C. wiganianum*



- ***Dendrobium aggregatum***
- ***Dendrobium agrostophylum***
- ***Dendrobium amoenum***
- ***Dendrobium capillipes***
- ***Dendrobium crepidatum***
- ***Dendrobium cumulatum***
- ***Dendrobium densiflorum***



Dendrobium spp.



Dendrobium devonianum

Dendrobium farmerii

Dendrobium farmerii

Dendrobium fimbriatum

Dendrobium formosum

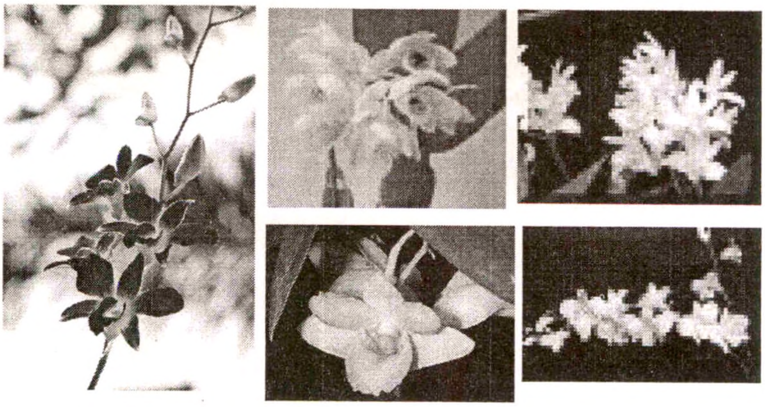
Dendrobium jenkinsii

Dendrobium gibsonii

Dendrobium lituiflorum

Dendrobium ochreatum

Dendrobium spp.



Dendrobium sonia

Dendrobium sulcatum

***Dendrobium* bardo rose berowro small**

Dendrobium arcuatum

***Dendrobium* candy strip x bm white small**

Dendrobium chrysotoxum

Dendrobium compactum

Dendrobium delicatum

Dendrobium golden blossom

Dendrobium kingianum small

Dendrobium kuniko small

***Dendrobium* no name 2**

Dendrobium nobile hybrid

Dendrobium nobile virginalis

***Dendrobium* nugget x king falcon**

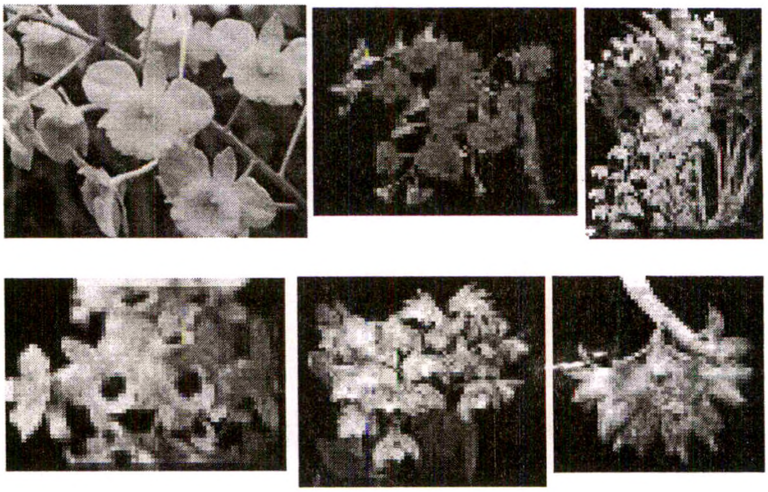
***Dendrobium* spellbound**

Dendrobium victoria reginae

***Dendrobium* yukidalma Small**

***Dendrobium* yumeji small**

***Dendrobium* yellow paney march**



Dendrobium spp.

Growth Habit :

- Terrestrial (grown on the ground)
- Epiphytic (grown on the host plants) and further divided into two separate groups, e.g. monopodial and sympodial
- Saprophytic (grown on dead or decaying organic matter)
- Epilithic (grown on the rocks)
- Semi-aquatic (grown in water)

Environmental Factors :

Temperature

- Excessive temperature is a problem specially during night, when respiration rate becomes higher at the expense of food reserve.
- Ventilation and humidity can bring down the temperature.
- Sudden change of temperature is bad.

Light

Light is essential for orchids. They, however, require less light intensity compared to common garden plants and hence are grown under greenhouse conditions. The requirement of light varies with the genera. Some plants prefer to be grown under open condition; some partial shade and others are completely shade loving types. Most of the orchids require partial shade for their optimum growth and in cool climate; they can effectively be grown under full sunlight.

Quantity and Quality of Light

Quantity and quality of light determine whether orchids will bloom to their potential or not. If orchid plants are looking healthy but not producing flowers, then it is most likely that the plants are not receiving enough light. Exposure from the south side with moderate shading would be optimum for majority of them.

As orchids require dark period to complete their metabolism, very long day persisting periods can be detrimental. Orchids normally never be exposed to more than 16-hour daylight. The best clue can be obtained from their natural growing conditions (habitat). High light condition is essential for the successful growing of *Cymbidium*.

Intensity of Light

More light is not a problem in most of the cases, except the accidental or sudden exposure to higher intensity of light. Sudden or rapid change from lower to higher light intensity can lead to sunburn symptoms.

Most common symptoms of insufficient light are dark green foliage, leaves and pseudo-bulbs are unable to stand erect, older leaves fall prematurely and plants look very weak and fluffy.

They will not produce regular blooms or may produce very few blooms, new growths will be smaller than the previous ones and often coupled with increasing susceptibility to disease.

- ***Vanda***—reduction in sunlight results in late commencement of flowering and lower yields.
- ***Cattleya***—better performance under high light intensity.
- ***Cattleya, Cymbidium*** and ***Phalaenopsis***—fluorescent light better than high intensity discharge lamp (HID) and greenhouse light.
- ***Bulbophyllum***—direct exposure to full sunlight would lead to sunburn injuries.
- ***Epiendrum radicans***— adverse effect under more than 50% shade.
- ***Dendrobhim* and *Vanda***—well at a light intensity between 2400 to 3600 foot-candle.
- ***Dendrobium, Oncidium*** and ***Phalaenopsis***—shade loving orchids, do not tolerate direct exposure to tropical full sun.
- ***Cymbidium, Dendrobium*** and ***Oncidium***—Maximum photosynthetic rate under 20-30 Klux light intensity.
- ***Arachnis, Ascocentrum, Renanthera*** and ***Vanda*** require full sun for free flowering.

Cymbidium can Flower Year Round

Cymbidium maintained first under long day and warm condition and then shifted to night temperature of 10°C to become generative.

Plants maintained continuously under 16 hour photoperiods and at 20°C day and 14°C night temperatures, all developing buds became inflorescences. By this method, ***Cymbidium*** could be kept on flowering throughout the year.

Shade Requirement

- Shading lowers crop temperatures and produces higher quality crops. The shading requirement of different orchids varies.
- ***Dendrobium***—cultivation in Kerala by using a double layer roofing system consisting of a shade net at 4.5 m (providing 25% shade) and a lower shade-net at height of 2.5 m which can be altered according to weather.
- ***Oncidium***—best inflorescence quality under one 50% shading net.

Cymbidium Tracyanum **under diff. agro-shade nets at Kalimpong :**

Plant characters	**UV stabilized agro-shade net level**		
	30% shade	**50% shade**	
Plate height (cm)	68.15	69.10	64.45
Shoots per plant	2.40	2.45	2.20
Length of shoots (cm)	9.65	11.05	9.25
Leaves per plant	7.75	10.00	7.95
Length of leaves (cm)	58.50	59.75	60.45
Breadth of leaves (cm)	2.10	2.35	1.90
Flower length (cm)	11.50	11.95	—
Flower breadth (cm)	11.00	10.50	—
Spikes per plant	2.50	2.67	—
Flowers per spike	14.80	15.20	—
Life of flowers on plants (day)	28.33	29.25	—

Humidity

Humidity in the growing area is important. Humidity can be created by thorough damping down of the green house floor and staging early in the day and again later on hot days. Growing environment can be kept moist by installing a humidifier or a misting system.

Air Movement

- The commonly cultivated orchid species (epiphytes) require air movement throughout the growing area.
- During very hot days, free movement of air reduces the temperature inside. Installation of fan does this effectively.
- Movement of leaves and flowers as in natural garden can be simulated inside greenhouse by oscillating fan, providing side curtains and top vents.
- The epiphytic orchids draw nutrition from air. Therefore movement of fresh air inside greenhouse is effective.

Growing Media

- Provide support to the orchid plants
- Supply water and nutrients to roots
- Provide good drainage and aeration

The type of medium varies with habit of orchids.

Several Potting Materials used Worldwide with Good Results

- Tree bark
- Osmunda fibre
- Tree charcoal

- Brick
- Polystyrene granules
- Compost
- Pumice
- Poultry manure
- Styrofoam
- Sand
- Stone chips
- Coconut husk
- Rock wool
- Vermiculite
- Horse or cow dung manure
- Leaf mould
- River shingles
- Sphagnum moss
- Beech or oak leaves
- Perlite
- Peanut shells
- Top soil
- Loam

Media :

- ***Bulbophyllum***—soft tree fern stem with a little sphagnum moss around the roots
- **Terrestrial type of *Coelogyne***—mixture of equal parts of sphagnum moss, leaf mould, white sand and loamy soil
- ***Aerides midiflorum***—hardwood charcoal
- ***Dendrobium*** hybrid seedlings—hardwood charcoal, Fern wood, coconut husk, wood chips and sphagnum moss, either alone or each mixed with horse manure (3:1).
- ***Eria*** species—osmunda fibre, fibrous loam and sphagnum moss in equal proportions.
- ***Calanthe***—medium comprising of sandy loam, leaf mould, chopped tree fern, white sand and well-rotted cow manure.
- ***Dendrobium moschatum***—media having 3 parts sphagnum moss + 1 part manure.
- OffMix, a commercial mixture developed at Rutgers University, is basically a combination of fir bark, peat and perlite.
- ***Aerides, Cattleya, Dendrobium, Vanda***—equal parts of charcoal, brick pieces, coconut fibre and leafmould
- **Terrestrial orchids, *Cymbidium, Calanthe, Phaius, Thunia***—compost containing 1 part each of, river sand, leaf mould, charcoal dust and old mortar.
- ***Cymbidium***—physical characteristics of substrate, especially higher bulk density, water holding rates and porosity are important factors.
- ***Cymbidium goeringii***, grown in ceratone and bark (porosity–26%) showed better growth, root length.
- ***Cymbidium*** 'Moon Venus', substrates with high water holding rate (40-50%) and suitable bulk density (0.2-0.3).
- ***Dendrobium fimbriatum, D. moschatum, D. farmeri*** and ***D. nobile*** were

grown on different combinations of charcoal, brick (fragments), gravel, coconut fibre and coconut husks.

A combination of brick and gravel was considered the best medium with regard to cost-effectiveness as well as growth.

Mixtures of gravel + coconut fibre, gravel + coconut husks, brick + gravel, brick + coconut fibre, brick + coconut husk and charcoal + brick + gravel + coconut husk gave the best results.

- ***Vanda rothschildiana***—media comprising of brick pieces + coir dust
- ***Dendrobium***—pots containing charcoal + brick + coco peat or charcoal. Highest number of roots recorded in plantlets grown in charcoal only. Potting mixture in Shillong - coal + moss grass + bricks pieces + litter.

Coconut Fibre as Medium

Coconut fibre is a good growing medium. The properties of coconut fiber are examined and compared with those of other alternative substrates such as bark humus, rice husks and polystyrene. The dry volume weight is 100-200 g/l, pH 4.4-5.9 and water capacity 20-70 volume % depending on fibre length. Nutrient and salt contents vary greatly. The fiber is considered particularly suitable for orchid growing and for flood irrigation.

AICRP on Floriculture Kalimpong Report :

- ***Dendrobium nobile, D. densiflorum***—medium consisting of coconut fibre + charcoal + brick pieces (1:1:1).
- ***Cymbidium elegans***—medium consisting of loamsoil + leaf mould + river sand + charcoal + old mortar (1:1:1: **1/2** : **1/2**).
- ***Cymbidium*** Soulhunt 200—media containing cocopith: loam soil: coconut fibre(1:**1/2**: **1/2**).

Nutrition :

- Feeding is an important aspect for culture of orchids.
- Adequate fertilization is most essential in epiphytic orchids since the media are devoid of nutrients
- Media cannot hold the nutrient in it.
- Quality and frequency of application of nutrient largely depends upon the habit (epiphytic or terrestrial), phase of growth (rest or active growing period), growing media like sphagnum moss or osmunda fibre, leaf mould, cowdung manure etc.
- Better to standardize and follow the nutrient schedules for each section of orchids.

- Orchids are epiphytic, they could only be grown in media having balanced nutrition, which can be supplied only through liquid fertilization.
- Growth and flowering in orchids are improved by a regular scheduling of fertilizer spray to the plants in liquid form.
- Frequency and dilution of the fertilizer solution depends on the growth and flowering behaviour of orchids.
- In order to avoid deficiency of nutrients, trace elements like Mn, Fe, B, Zn and Mo can be sprayed once or twice a month. Organic manure like cow dung or neem cake after making solution can be used as foliar spray once a month.
- Fertilizer mixture of N, P and K (18:18:18) dissolved in water @1g/l can be applied once a week from late spring to early winter and fertilizer solution containing more amount of nitrogen (30:10:10) during remaining part of the year.
- Amount of nitrogenous fertilizers to be applied vary with species and season of growing.
- Application of equal proportion of fertilizers gives good response in *Dendrobium* but a higher proportion of N proves optimum for the growth and development of cymbidiums.
- ***Eria*** -NPK can be given to strength of 17:17:17 or 20:20:20 dissolved in water @1-2 g/l applied twice a week. When the young plants are grown to mature stage, high phosphorus and potash fertilizers can be given in the ratio of 10:20:30 to help flowering.
- Over-fertigation is dangerous, leads to salt deposition in pots. It can be identified in form of white crusts on the medium and around the pot.
- Dyeing of leaf tips is also an indication of salt deposition. Roots also turn black when they come into contact with the salt deposition in pots. Orchids have very low tolerance to excess salt.
- Orchids require nitrogen, phosphorous, potash and trace elements for healthy growth. Even beer at strength of one quart in 10 gallons of water to be beneficial for orchids.

Foliar Application?

Effectiveness of foliar application of nutrients in orchids is a debatable issue. The rate of absorption by leaves was less than one eighth of that observed for roots.

Balanced Fertilizer :

- Orchids grow satisfactorily when fed with a balanced fertilizer for about 10 months a year except in the period when plants are in new growth.

- During the new growth period, it is better to supply nitrogen rich fertilizer to them.
- Constant changes create dangerous imbalances that seldom give satisfactory results.

Guidelines for Fertilizing Orchids :

- Not to fertilize a dry plant
- Not to apply strong doses
- Orchids prefer weak solution of fertilizers frequently than higher doses less often
- Not to provide too much nitrogen during flowering as it is inhibiting
- Not to apply high nitrogen fertilizer on small seedlings as it leads to weaker plants
- Not to fertilize sick plants
- Fertigation should be done once a week while in active growth
- Once every other week when it is not in active growth

AICFIP, Kalimpong, Standardized Nutritional Requirement:

For terrestrial and epiphytic orchids, Ohio W.P. solution is recommended to spray once a week. The concentration of nutrients in the solution may be more in summer than in the winter-

Ohio W. P. Solution

- KNO_3 – 2.63 g
- $MgSO_4$ – 2.04 g
- Mono Ca_3 $(PO_4)_2$–1 g
- H_2O- 4.5 l
- $(NH_4)_2SO_4$ – 0.4 g
- $FeSO_4$ – 1.09 g
- $MnSO_4$ – 2.5ml of 1%
- pH of the solution 5.5 – 6.0

Nutrition

- NRC for Orchids at Pakyong reported that growing media containing leaf mould+ FYM+ charcoal+ coconut husks+ brick bits(2:1:1:1:1) and spraying with N@300 ppm +P @200 ppm+K@100ppm+BA@ 200ppm +GA3 @200 ppm recorded the max. plant height of *Cymbidium* Soulhunt-6. Number of leaves were highest in potting mixture having leaf mould +FYM+ charcoal+ coconut husks+ brick bits(2:1:1:1:1) and spraying with N@200 ppm+P@100ppm+K@100ppm+ BA 100ppm + GA3 @100 ppm

Water Management

- Avoid continuous wetting of root zone in early growth stage.
- More water more frequently for fresh potting material.
- Potting material with high WHC needs less water less frequently.

- Water more frequently in summer in dry weather.
- Watering at the morning hours.
- Second watering at the evening hours to dry off before night.
- Small pots dry out faster, needs frequent watering.
- Orchids on hanging baskets require frequent watering.
- Hose, mist units, foggers, humidifiers are common devices.
- Water quality is important. pH 5.5-6.5. High chlorine detrimental.
- High salts like Ca, Mg, Na etc. lead to slow death of plants.
- Monopodials prefer high humidity except shade loving ones eg. *Phalaenopsis* as compared to sympodials.
- Monopodials with arched leaves (Vanda, Ascocenda, Aerides, Mokara etc.) retain water in leaf axils and collar region may rot. *Phalaenopsis* is an example.
- Water logging prevents root aeration,encourages disease incidence.
- Over watering breaks down the potting materials.
- Under water causes stunted,weak growth,arrests new growth.
- Slightly acidic water is good
- *Catteleya* and *Oncidium* require drying between watering.
- *Phalaenopsis* and *Vanda* require frequent watering.
- *Cymbidium* and *Phaius* need abundance of moisture with drainage.

Care

- Keep the area clean.
- Use the correct dose of appropriate chemicals.
- Destroy beetles, their pupae, snails, slugs by handpicking.
- Take care during spraying.
- Inspect every plant regularly.
- Remove and destroy infected plants.

Economics of Production:

- *Dendrobium* is widely accepted for commercial production for easiness in housing and management.
- It starts flowering after 5-6 months when raised from medium sized plants.
- The primary flowers are smaller, improper colour and shape.
- Production of 5-7 spikes in 2nd year and 6-8 spikes from 3rd year onwards.
- From 4th year onwards, one plant is available for sale from each plant.
- Plants can be maintained economically for several years with slight decline in every 5-6 year.

Establishment Charges

Area : 100m²	**No. of plants: 1000**
Item	Total cost (Rs.)
Land development	2500
Cost of shade structures	25000
Platform and second level roofing @ Rs.250/m²	15000
Irrigation system	5000
Planting material @ Rs. 40 each	40000
Pots, media, planting charge @ Rs. 8/- plant	8000
Pesticides, fertilizers tools and application charges	2000
Office equipments and stationary	2500
Total	100000

Recurring expenditure

Cultivation expenses @ Rs. 1.00 per plant	Rs. 1000
Irrigation expenses @ Rs. 2.00 per plant	Rs. 2000
Pesticides, fertilisers, labour, packing, transporting etc. @ Rs. 2.00 per plant	Rs. 2000

Yield and returns

Item	I year	II year	III year	IV year	V year
No. of spikes @ Rs.6/plant	2000	6000	8000	8000	8000
Cost of spikes @ Rs.10/spike	20000	60000	80000	80000	80000
No. of plants	Nil	Nil	Nil	1000	1000
Cost of plants @ 40 each	Nil	Nil	Nil	40000	40000
Total	20000	60000	80000	1200000	1200000

Post-Harvest Management :

- Orchid flowers are very high value commodities.
- Out of many genera, only few such as ***Cymbidium, Paphiopedilum, Cattleya, Phalaenopsis, Vanda, Dendrobium*** and ***Oncidium*** **etc.** are grown commercially for cut flowers.

Cause of Decline in Vase Life :

- Orchid flowers are very sensitive to ethylene. Especially when flowers get pollinated or when pollinia get damaged, ethylene production from the flowers increases, which eventually causes senescence. Therefore the flowers must be handled carefully.
- Exposure of flowers to ethylene also shorten the vase life. Since orchid

flowers can not be cooled, loss of water during transit also leads their desiccation.

- Therefore, orchid flowers should be transported under wet conditions.

Harvesting of flowers :

Generally ***Cattleya, Cymbidium*** flowers are harvested 3-4 days after opening. Stems of ***Dendrobium*** are cut when all the florets are almost open. Flowers cut early wilt quickly. Since orchid plants are perennial and produce flowers for many years, the flowers are cut with sterilized tools to check the spread of viruses. Immediately after harvesting the stem should be put in vials containing water and fitted with rubber and plastic cover.

Stage of Harvest:

- Orchid growers get an opportunity to enjoy the flower themselves for a few days and to trade it later on.
- Correct stage of harvest influences the keeping quality and adds to the attraction of harvested spikes.
- Longer spikes of *Dendrobium, Phalaenopsis, Aranda, Arachnis* are harvested when 3-4 buds are still unopened. The no. of unopened buds to be retained may be lesser in smaller spikes.

Method of Harvesting :

- The spikes are cut at the base of stalk and close to the stem.
- The cut surface should be smooth and should never be crushed.
- A sharp secateur or knife can be used.
- Dipping of knife in an antibiotic fungicide mixture and pasting the mixture on the cut surface to avoid disease transmission.
- Flaming of cut surface can also be done.

Post-Harvest Operations :

- Harvested spikes are immediately dipped in bucket of water till they are packed.
- Entry of air can be prevented if second cut of stem is made under water.
- For improving quality and vase life, pulsing treatments should be given.
- Sucrose 6%, BA 75 ppm or HQ 500 ppm + Sucrose 5% for 6 hrs improve vase life.
- For improving vase life, cut spikes are kept in holding solution of $AgNO_3$ 25 ppm, + Sucrose 5% + or HQ 400 ppm.
- The cut end should be covered with wet cotton, polythene wrapping using a rubber band.

Effect of Natural and Chemical Preservatives on the vase life of *D. Sonia* :

Treatment	Vas life (days)	Bud opening (after 9 days)	Water uptake (ml)	Wt. loss (g)
T_1	13.67	8.33	16.27	1.13
T_2	11.67	15.33	14.57	1.31
T_3	9.33	21.67	12.07	1.22
T_4	9.00	18.33	10.23	0.99
T_5	10.00	28.33	11.77	0.92
T_6	21.67	63.33	25.13	0.48
T_7	24.67	53.33	29.33	0.37
T_8	16.33	70.00	19.46	0.56
C.D at 5%	0.86	5.88	0.62	0.06
S.E.	0.29	1.96	0.20	0.012

T_7 CW – 60% + Sucrose – 6% + $AGNO_3$ – 30 ppm

Floral Preservatives :

Cymbidium

- 8-HQC – 200 mg/l + Sucrose-1%

Dendrobium

- $AgNO_3$ – 300 mg/l + Sucrose-4%
- 8-HQC – 225 mg/l + Sucrose-4%
- 8-HQC – 200 mg/l + Sucrose-2%

Experiment with Preservatives :

T_1 Coconut water – 25% + Distilled water – 75%
T_2 C.W 50% + DW 50%
T_3 CW 75% DW 25%
T_4 CW
T_5 CW + Sucrose 4%
T_6 Sucrose 4% + $AgNO_3$ – 20 ppm
T_7 CW – 60% + Sucrose – 6% + $AGNO_3$ – 30 ppm
T_8 Control (DW)

Conclusion :

Coconut water 60% + sucrose 6% + $AgNO_3$ – 30ppm is the best combination of natural and chemical preservatives for longer vase life *D. sonia*

Storage of Flowers :

- Tropical and sub-tropical orchid flowers can't be stored for prolonged period.

- The flowers can be stored wet at 7-10°C for 2 weeks. Temperature lower than 7°C because browning and necrosis of flowers.
- Temperate orchid flowers such as *Cymbidium* can be stored at –0.5-4°C.
- Since orchid flowers are sensitive to ethylene, stems should be pretreated with anti ethylene preservatives before packaging or transport.

Grading and Packing :

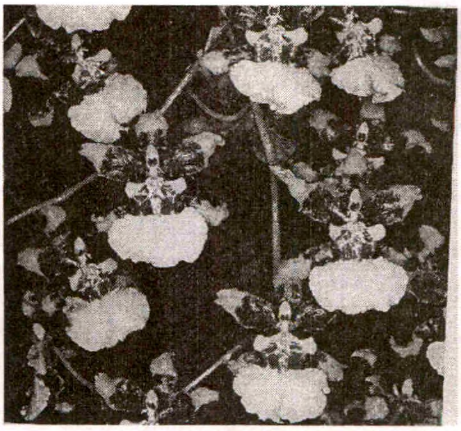
- No uniform grading system for orchid flowers.
- Grading based on length of spike, numbers of florets per spike, shape, size and arrangement of florets and numbers of lateral branches on spike.
- The pollinated and dirty flowers should be culled.
- The stems are put in vials containing water. The vials are sealed with rubber or plastic stopper or alternately the stem bases can be tied in water soaked cotton wads wrapped polythene wrapper.

Packing :

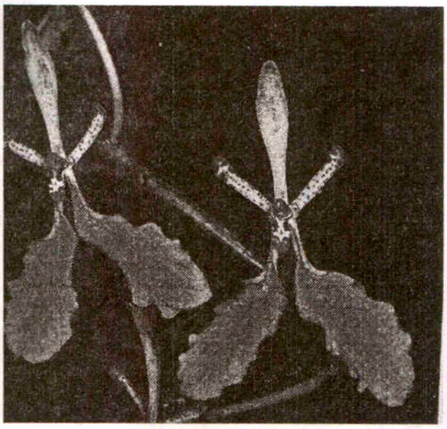
- Stalks are usually packed in cartons.
- Size of cartons is determined by genera and no. of spikes to be packed.
- *Archnis* require longer cartons as compared to *Vanda* and *Dendrobium.*
- *Archnis* has compact sturdy and hence can be closely packed.
- *Phalaenopsis* and *Oncidium* etc. require more space as they are of more branching nature with relatively delicate flowers.
- Generally 50–100 spikes are packed in a carton.
- Cartons are provided with sufficient no. of holes all around to facilitate good aeration.
- The prepared spikes are tied in bundles of 10 before packing in cartons.
- It is preferable to provide a lining with newspaper inside the carton. This will not only blot out excess water but also maintain humidity.
- Polythene 50 guage is good lining for *Dendrobium.*
- To prevent movement of spikes with in cartons during transit, base of the bunch of spikes or bottles are tied to the base of the cartons or fastened using an adhesive tape.
- Sufficient packing may be provided between the bunches and cartons using shredded papers.
- This keeps the flower from rubbing and bruising each other.
- After filling cartons, the top may be covered with newspaper.
- Then the cartons are closed and joints are sealed with adhesive tapes.

Transport :

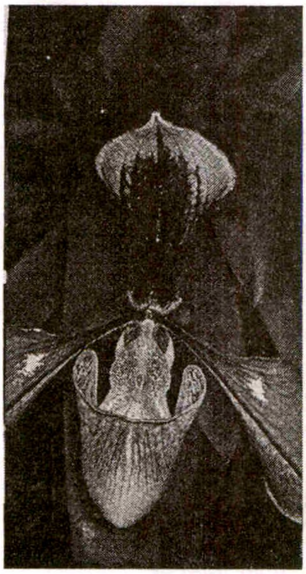
- Flowers are largely transported by air or sometimes by trains.



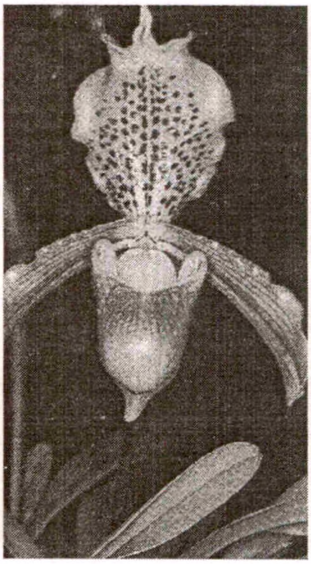
Oncidium sphacelatum



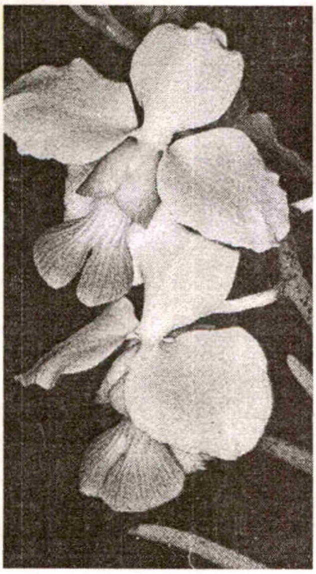
Renanthera imschootiana



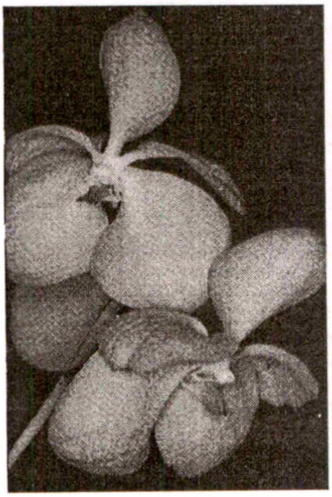
Paphiopedilum villosum



Paphiopedilum insigne

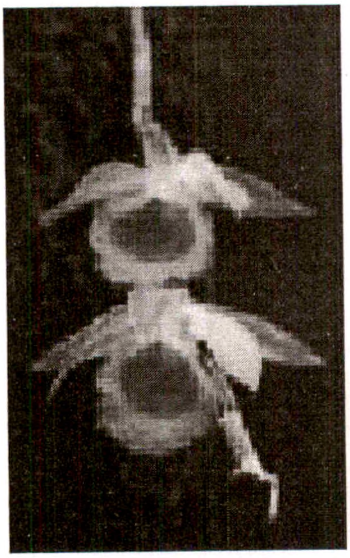


Vanda teres



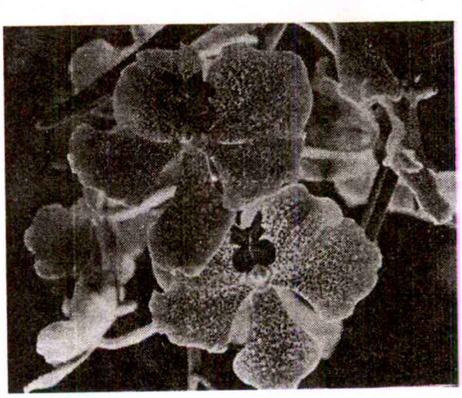
V. coerulia

Thunia alba



D. lituiflorum

Catteleya hybrid



Phalaenopsis

- Proper labeling on the boxes will help in careful handling.
- Refrigerated transport is always advantageous.
- Each stem should be placed in plastic sleeve to protect from physical damage during packing and transport.
- The flowers are packed in corrugated telescopic boxes and can be shipped to longer distances in good condition.
- Immediately after transport, the stems should be re-cut and put in water for re-hydration.

Marketing :

- Presently orchids are sold out internally in cities like Delhi, Mumbai, Chennai, Kolkata, Bangalore, Guahati and Pune.
- Easy to find out a wholesaler to buy the flowers if there is a steady supply of flowers at a definite frequency.
- A cooperative can take care of marketing if large no. of growers are located nearby.

Care of Flowers at Florist's Shop :

- When the flowers are received after transit, they might have lost water and sometimes show wilting sign. Basal 2-3 cm of such stems should be re-cut. The stems should be put neck deep in water or preferably acidifying in solutions such as citric acid (300 ppm). The process called hydration, restores turgidity of the flowers and improves their vase life.
- Vases should be kept clean and change vase water daily.
- Discard damaged part of stem. It produces more ethylene and invite infection.
- Floor of shop should be disinfected regularly and kept clear of the plant debris or damaged/senescing flowers.

PRODUCTION OF SEED AND PLANTING MATERIALS IN FLOWERS : ITS PROSPECTS

Asit Kumar Basu

Introduction :

India is one of the leading country for food production, food security is contributing agriculture produces & stands among first few countries in the world. Around 600 million agri produces are given by India. Among cereals producing country the standing of India remains the same after green revolution. India has to move fast for producing more pulses & oil seed crops for becoming independent in food. In addition to other reasons the quality seed & planting materials is one of the main cause for not providing that much yield as we expected. For agriculture & Horticulture too, the seed materials is considered as one of the most important inputs for more & quality production of any crop.

Seed materials are susceptible & naturally infested with no of organisms & this has to be well protected. Many of the crops are being infested through seed soil Bourne diseases. In most of the case the loss of crops due to the ill treatment or no treatment of seed materials with technology. In recent times Government is also insisting the Farmers through meeting, training programme, and awareness programme for going through the proper seed treatment procedures for different crops in order to avoid huge crop loss.

Advantage of Seed Treatment :

1. Treated seed prevent infestation of disease to cyoug plnts
2. To prevent the plant against rot & Blast
3. Prevent the seed for insect attack
4. Control seed form attack from soil borne insect, Disease etc.

Class of Seed Treatment :

1. Sterilization of seed
2. Seed disinfection
3. Seed protection & preservation

Time of Treatment of Seeds :

1. Injured seed
2. Diseased seeds
3. Soil condition
4. Disease free seeds

Machinery Used for Treatment of Seeds.

1. Slurry Treater 2. Direct Treater 3. Home made drum seed Mixer
4. Graing auger 5. Shoevel

Basic Principles for Flower Seed:

- Horticultural crops, especially flowers, show wide range of variation both in form and habitat requirement.
- The variations are either genetic structure—avoid through checking genetic deterioration.
- Variation due to environment—avoid through growing of the crop in the environment for which it has been evolved—produced seeds there.

Seed Materials for Flower :

- Requirement of variety Changes more rapidly earlier crop growing has mostly limited to home gardeners and home consumption, but export of the produced has been advanced with the development of transport system.
- Accordingly, continuous development of varieties is necessitated, especially to suit these conditions as well as due to changing socio-economic structure.
- Main objective must be to evolve varieties superior to those already in trade.
- Seed production of promising types is required.
- Lot of emphasis has been given to development of new biotechnologies for seed production and presentation/storage.

Commercial Seed Production :

- Exploitation of Hybrid vigour in ornamentals was first made in Japan in the early forties of the last century to produce all double F1 Petunia.
- Presently F1 Hybrids are available in almost all flower crops starting from 'A' (Antirrhinum) to 'Z' Zinnia.
- Numerous creative approaches are being employed in production of hybrids—use of m.s. lines, artificial seed production, use of vacuum pump for pollen collection, long term storage of pollens, etc.
- Production of F2 seeds are growing popularly–cheaper than F1 seeds–Antirrhinum, Petunia and Pansy, etc.
- Diverse agro climatic condition–provide vast scope for seed production of wide range of flowers.
- Availability of cheaper human labour, technical expertise and other inputs —help to organize flower seed production for export purposes.

Development of Strong Seed Programmers is required to meet the needs of the Importing Countries, for which basic considerations are :

- Assessment of world seed demand their consistency or stability and approximate pricing structure.
- Survey of identify the centers of excellence for crop specific quality seed production.
- Promotion of seed trade—both for internal and International customers.
- Development of basic infrastructure.

MANAGEMENT OF MAJOR DISEASES OF COMMERCIAL FLOWERS IN EASTERN INDIA : A BIORATIONAL FUNGICIDE APPROACH

Sujay Saha

Introduction :

The Eastern tract of the country accounts for about 19.64 per cent of the floriculture acreage in India which is around 13,000 Ha. The target of flower exports in 2010 is 375 crores as against the present day export of 235 crores. This accounts for only about 0.11 per cent of the billion global trade. To elevate India's share in the global market, production of quality flowers is a mandate. Biotic stresses, especially diseases take a heavy toll on the quality of flowers, and hence developing location specific packages and stewardship of Integrated Pest Management (IPM) is the need of the hour.

The major diseases of commonly grown flowers and their management with specific biorational fungicides are briefly discussed below :

Chrysanthemum :

♦ Leaf spot (c.o. *Cercospora chrysanthemi/Septoria chrysanthemi*).

Yellow spots are seen on the upper surface of the leaf which coalesce to give rise to irregular spots. Later, they become necrotic and dry.

Clean cultivation and manual removal of infected portion reduces the disease inoculum; 2-3 sprays of chlorothalonil (kavach) @ 1 g/litre of water of thiophenate emethyl (Topsin M/control) @ 0.5 g/litre of water, at 15 days interval with control the disease.

♦ Powdery mildew (c.o. *Erysiphe cichoracearum*)

While powdery growth is seen on the leaf surface. The leaves become purchased and distorted. The disease spreads in hot and humid condition.

Spraying of myclobatanil (Index) cig/10 litres of water or triadirefon (Bayletow) @ 0.25 g/litre of water or flusilazole (cursor/nustar) @ 0.25 g/litre of water @ 10 days interval reduces the disease.

♦ Gray mould (c.o. *Botrytis cinerea*)

The symptoms are evident during cloudy and humid conditions. Water soaked spots are seen on the leaves and petals which later gets covered with grey to brown powdery mass.

Welting of flowers should be avoided during watering. 2 sprays of chlorothalonic (karoch) @ 0.5 g/litre of water or mancozeb (Manzate, Indofil M-4 etc) @ 1 g/litre of water or azoxystrobin (Amistar) @ 0.5 m/litre of water at 15 days interval can control the disease effectively.

- **Bacterial Blight (c.o. *Erwinia carotovora*)**

Water soaked lesions are seen on the stem. The stem tip blackens and bud death occurs. Rapid wilting of the plant is also observed.

Removal of plant debris along with lowering of humidity reduces the disease. The plants should be spaced out properly to increase air circulation in order to abate bacterial growth.

Rose :

- **Black Spot (c.o. *Diplocarpon rosae*)**

Small, circular black spots are seen on the upper surface of the leaf with feathery margins. Dark purple to black acervuli are seen on the spots. High humidity predisposes the disease, and the disease spreads through splasting rain, gardeners and insects.

The infected twig should be pruned and copper hydroxide (Hidice, Kocide) paste must be applied on the cut surface to avoid secondary infections. Spraying of carbendazim (Banistin, Derosal etc.) @ 0.5 g/litre of water or chlorothaloni (Kavach) @ 0.5 g/litre of water also reduced the disease.

- **Powdery Mildew (c.o. *Sphaerotheca* sp.)**

White powdery growth is seen on the surfaces of the leaves which later get distortu.

Two sprays of myclobutanil (Index) @ 1g/10 litres of water at 15 days interval can successfully control the disease.

- **Blight (c.o. *Botrytis cinerea*)**

The buds fail to open and are covered with grey mould. The stem becomes discoloured. Moist air along with cool temperature increases the severity of the disease.

The infected parts are destroyed to prevent the spread of the disease. Spraying of cashendazion (Bavistin, Dhanustinete) @ 0.5g / litre twice, at 10 days interval also eradicates the pathogen.

Sunflower :

- **Downy Mildew (c.o. *Plasmopara halstedii*)**

White cottony mass is seen at the lower surface of the leaf. The plant gets dwarfed and becomes pale yellow in colour. Head and seed production does not occur. Flat topography and water logging predisposes the disease.

Light, well drained soil should be preferred. 2-3 sprays of cashendazin (Desosal, Bavistin etc.) @ 0.5 g/litre of water or Iprodione + Carbendagin (Quintal) or Fenomidena + Maneozeb (Sectin) @ 0.25 g/litre of water at 10–12 days interval as effective in managing the disease.

◆ **Rust (c.o. *Puccinia helianthii*)**

Brown coloured pustules are observed on stems, leaves, petioles and back of Lead, which gradually turn black. The disease aggravates in high moisture conditions and warm temperature.

Use of tolerant varieties is the only remody of the malady.

◆ **Leaf Spot (c.o. *Septoria helianthii*)**

Water soaked angular spots are first seen on the lower surface and later on the upper surface. Yellow hals is also seen around the spots. Future spots have Sark coloured printing bodies on them. High temperature and modrate rainfall favours the development of the disease.

The disease can be controlled by adopting similar strategies as in case of leaf spot of chrysanthemum.

◆ **Head Not (c.o. *Sckeritubua sckerituiryn*; *Rhizopus* sp; *Botrytis* sp.)**

Rotting of stalk, head and root occurs. Sudden wilting is also observed. Soil drench with carbendazim (Derosal, Bavistia etc.) @ 1 g/litre of water may yield good results, but growing of tolerant cultivars is advised.

◆ **Charcoal Rot (c.o. *Tacrophomina phaseolina*)**

At the collar region grey lesions are observed. Stem becomes hollow and starts rotting. Root also decays and the plants give a shredded appearance. In sere cases, the plants lodge.

There should not be any moisture stress and nitrogenous fertilizers should be avoided. Crop rotation along with low crop population is useful in the management of the disease. Insect damage should be avoided. Soil amendment with *Trichoderma* sp. formulation night also proves beneficial in controlling the disease.

Gladiolus :

◆ **Scab (c.o. *Pseudomonas marginate*)**

Yelowish spots are found on the corms which later terms brown. These sports later sink to form craters through which seepage of fluid occurs.

Drencting of soil with Copper Lydroxide (Hidice; Docide) @ 2.5–3 g/litre of water reduces the disease considerably. Soil amendment with *Pseudomonas fluorescens* formulations is also recommended.

- **Corm Rot (c.o. *Fusarium oxysporum var gladioli*)**

Yellow of older leaves occur while the younger leaves are stunted in growth. The corm turns brownish and rots.

Growing of tolerant varieties is recommended.

- **Rust (c.o. *Uromyces transversalis*)**

Dark brown pastules are seen on the leaf surface. The sori is covered with leaf epidermis which later splits and spores are released.

2 sprays of Carbendazim-Iprodime (Qunintal) combination @ 1.5 g/litre of water at 10–12 days interval or Azozystrobin (Amistar) @ 0.5 ml/litre of water at 15 days interval control the disease.

- **Colour Break Virus Infection**

The flower spike curls and becomes small. Corms become smaller and the plant is poorly developed.

Growing of tolerant varieties is recommended.

Marigold

- **Powdery Mildew (c.o. *Erysiphe cichoracearum; Sphaerotheca fuliginea*)**

White powdery growth is seen on surface of leaves and stem. The older leaves are more affected than the younger ones. Shady conditions and moderate temperature enhances the susceptibility of the plant.

Application of wettable sulphur @ 1.5 g/litre of water or Fenarimol (Rubigan) @ 1 g/litre of water or Myclobutanil (Index) @ 1 g/10litres of water or triadivefon (Bayleton) or azixystrobin (Amistar) or thiophenate methyl (control/Roks) @ 0.5g/ml per litre of water at 15 days interval can control the disease. 2-3 sprays should be given depending upon the severity of the disease.

- **Root Rot (c.o. *Phytophthora* sp.)**

The plants have a shunted and chorotic growth. The entire root rots and the willing occurs. Poor drainage, heavy soils and excess watering are the factors of increase in disease severity.

Soil drench with fenomidone-Maneozeb (sectin) @ 1g/litre of water helps in reducing the disease. The soil should be well drained and planting should be done in raised beds in order to manage the disease.

The plants are also infected by Wilt (c.o. *Sclorotium rolfsii*) and grey mould (c.o. *Botrytis cinerca*).

Orchids :

- **Leaf blight (c.o. *Glocosporium* sp.)**

Yellow spots are seen on the leaves which coalesce and later turns brown. Patches of lamixa drys up and the plant dies.

2–3 sprays of mancozeb (Dithane M-45/Manzaticte) @ 1 g/litre at 10 days interval controls the disease.

♦ Colour Mottle Disease (c.o. virus)

Variegated patches are seen on the petals. High humidity showed is avoided. The spacing should be proper to reduce overcrowding. Dusting of sulphur sometimes might reduce the disease.

In all the cases stickers/adjuvants should be used for better efficacy of the fungicides.

OPEN FIELD CULTIVATION OF ROSES

P. Pal

Introduction :

Rose is commercially important cut flowers, and pot plants have market demand throughout the year. This crop is grown in open field and greenhouse conditions. Open field cultivation face climatic hazards during its all stages of growth. We cannot expect more or less uniform quality blemish free cut bloom throughout the year from open field cultivation. Selection of cultivars is one of the important criteria for right cultivation of rose under open condition. Following are the factors for the selection of Cultivars:

- Suitability for the climate
- Form and shape of bloom
- Market value
- Stem length
- Flower colour
- Fragrance
- Yield

Cultivars Suitable for Cut Roses:

Name	Colour	Stem (cm)	Vase life (d.)	Yield (fls.m2/yr)
Dallas	Red	100	10	100
Grand Gala		90	8	130
Black Magic		80	12	170
First Red		70	10	130
Cobra		55	14	230
Papillon	Yellow	80	8	150
Skyline		80	8	120
Osiana	Pink	100	8	105
Vivaldi		90	10	120
Jacaranda Purple		70	6	190

Ideal Growing Conditions :

- Aerial environment strongly influence the growth and flowering of rose.
- Ned bright sunshine for the whole day.
- Temperature range 15–27^{0}C Humidity–60-65%.
- Optimum night temp. for quality and quantity of roses is 15.5^{0}C.
- At higher NT yield is more but quality is reduced.
- At low NT flower production reduced but improved the quality.

Growing Medium :

- Loamy soil with 10 to 12% humus content.
- Peat, rice husk. Coco peat, bark compost and F.Y.M. may be added.
- Media should be free from nematode and soil borne diseases.
- Sterilization (chemicals or heat) of medium is essential.
- Roses are extremely sensitive to water regime. So, irrigation water should be drain away easily, roots do not suffer from lack of oxygen or accumulation of salts.
- pH of the medium should be 5.5 to 7.0

Planting :

- Selection of planting material is most important.
- Plants should have a good root system and 4-branches above the budding point.
- Main export period of rose from tropical countries is October–March.
- May–June planted budded rose will produce 1st flush before October.
- Optimum planting time is October to March in open field conditions.
- At the time of planting bud union should be 4-5cm above the ground level.
- Planting may be done in 2 or 4 rows at a distance of 10 to 30 cm between plants and 25 to 30 cm between rows. Accommodate 60,000 to 70,000 plants/ha.
- Width of path in-between beds 60 to 80 cm.

Post Planting Care and Nutrition

- After planting, the soil around the plant must be kept moist but not too wet.
- Frequent overhead spraying with water is beneficial for quick establishment of plants.
- Other than major nutrients, iron, zinc, boron, molybdenum, manganese and copper are the supplementary elements need to be applied.
- Nutrition may be applied as broadcast or through irrigation water.

Nutrition :

- Rose like FYM, leaf mould in addition to oil cake and bone meal.
- Apply right fertilizer in right time& in appropriate amount. 180 Kg N + 180 Kg P_2O_5 + 190 Kg K_2O per ha.
- Dose varies from place to place.
- Apply in 3-split doses—1st 15 days after pruning, other two doses—after 1st & 2nd flush of bloom.

- Foliar feeding helps in producing healthy foliage & flowers big size, better colour & improved quality.
- Prepared a mixture of 15g $MnSO_4$ + 20g $MgSO_4$ + 10g chelated Fe + 5g borax—take 2g of that mixture & dissolve in water and spray on plant with spreading agent.

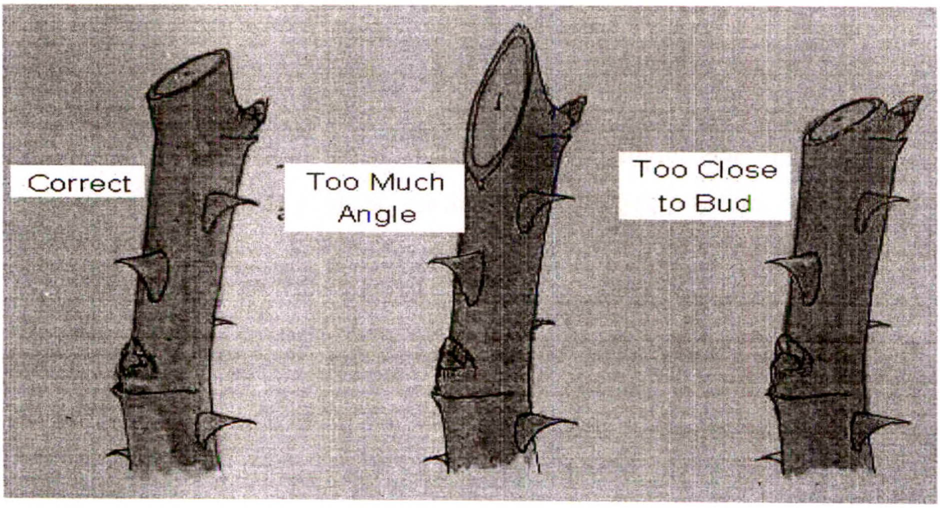
Irrigation :

- Adequate soil moisture is needed at all stages of growth.
- Frequency of irrigation is depending on stage of growth, texture of the growing medium and climate.
- In warm and dry conditions, overhead irrigation is beneficial to increase the humidity and decrease the temperature but the plants must be dry out before evening to avoid disease infestation.

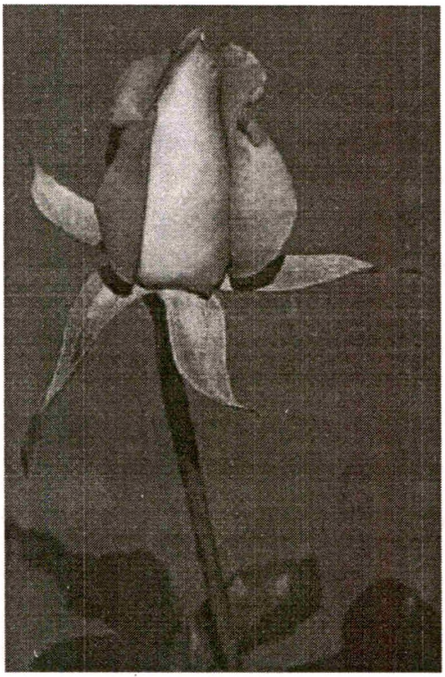
Pruning :

- Pruning improves flower quality and plant vigour and also removes diseased and unproductive shoots.
- Rose plant should be pruned the plant is at dormant or near to dormant stage.
- In pruning, cut is made at about ½ cm above a vigorous out growing buds.
- Cut should be slightly slanting.
- The cut should always be clean and sharp.
- A mixture of fungicide and insecticide should be paint immediate after pruning.

Pruning method



Stage of Harvesting :



Open field cultivation of aster

Harvesting and Yield

- The optimum stage may vary slightly depending on cultivars.
- Most pink and red flower cultivars should be harvested when one or two outer petals begin to unfurl.
- Flowers should be cut early in the morning before sunrise or late in the afternoon.
- Stem length should be little more than what is required and bear good number of leaves.
- Cut should always be above a healthy outward bud with a clean and sharp secateur.
- Immediate after cutting, the stem should be dipped in clean water upto the neck.
- Yield : 144 cut flowers per m^2.

1. Introduction

- Aster is commercially important cut flowers last long and are used in vases and floral decoration.
- Grown for bedding, potting and window-boxes
- Flower Color : Blue, lavender, pink, red, white, yellow
- This crop is grown in open field and greenhouse conditions.
- Open field cultivation face climatic hazards during its all stages of growth.

2. Types and cultivars

- Double—flowered aster is classified into 3 groups.
- Tall—60 to 80 cm tall cultivars—American branching, Bouquet powder-puffs, Paeony-flowered, Giant of California, Chikuma strain, Gala Lavender, Gala Yellow, etc.
- Medium tall—40 to 60 cm. cultivers—Early Burpeeana, Giant comet, Ostrich feather, Starlight Rose, Pompon, Liliput etc.
- Dwarf double—20 to 40 cm. cultivars—Pinocchio, Colour carpet, Dwarf chrysanthemum etc.

3. Cultivation

- Grow well in rich, well-drained loamy soil.
- Open sunny situation.
- At 10^0C night temperature aster produce fully double flowers with strong stem.
- At higher temperature produce weaker stem and less number of petals.

- Propagation.
- Seeds can be sown from August to October.
- Early sowing during August- September is useful for obtaining better bloom.
- **Comments :** Low drought tolerance.
- Seedlings are trans planted at 3-4 leaf stage.
- Spacing: 20×30 cm for tall group.
- 15×15 cm for dwarf group.
- Irrigation : Require continuous soil moisture throughout the entire period of growth and development.
- Nutrition : F.Y.m. 4–5t per ha during land preparations.
- 80-100 Kg N, 200Kg P_2O_5 & 200 Kg K_2O per ha applied in 2-split doses.
- Half dose of N and full doses of P_2O_5 & K_2O are applied as basal.
- Remaining N is applied at 10-12 leaf stage.

4. Harvesting and Yield

- Stage of harvesting determines its keeping quality.
- Harvest with stem when flowers develop their original colour
- Vase life–8 days
- Yield–7000 to 8000 flowers per ha.

FLOWER-ESSENTIAL OIL, EXTRACTION, PROCESSING, VALUE ADDITION AND QUALITY ASPECTS

Ashim Chowdhury and Saswati Pradhan

India's Advantages in Floriculture :

Diversified agro climatic and heterogeneous soil conditions.
Plenty of skilled relatively low cost labour.
Good irrigation potential.
Favorable sunshine hour.
Little or no rains in winter.
Domestic market.
Location of the subcontinent.
Govt. declared the sector as thrust area.
Increasing cost of production in the developed countries.

Status of Indian Floriculture :

Major States Contributing :

- Karnataka
- Andhra Pradesh
- Tamil Nadu
- Maharashtra
- West Bengal

According to a Report of the APEDA :

The total area under flower cultivation:	34,000 ha
Traditional flowers (marigold, jasmine, aster, rose, chrysanthemum, tuberose) :	24,000 ha
Modern flowers (carnation, rose, gerbera, gladiolus, anthurium) :	10,000 ha
The total returns from floricultural products :	Rs. 205 Crores
♦ Traditional flowers :	Rs. 105 Crores
♦ Modern flowers :	Rs. 100 Crores

The floriculture industry comprises of

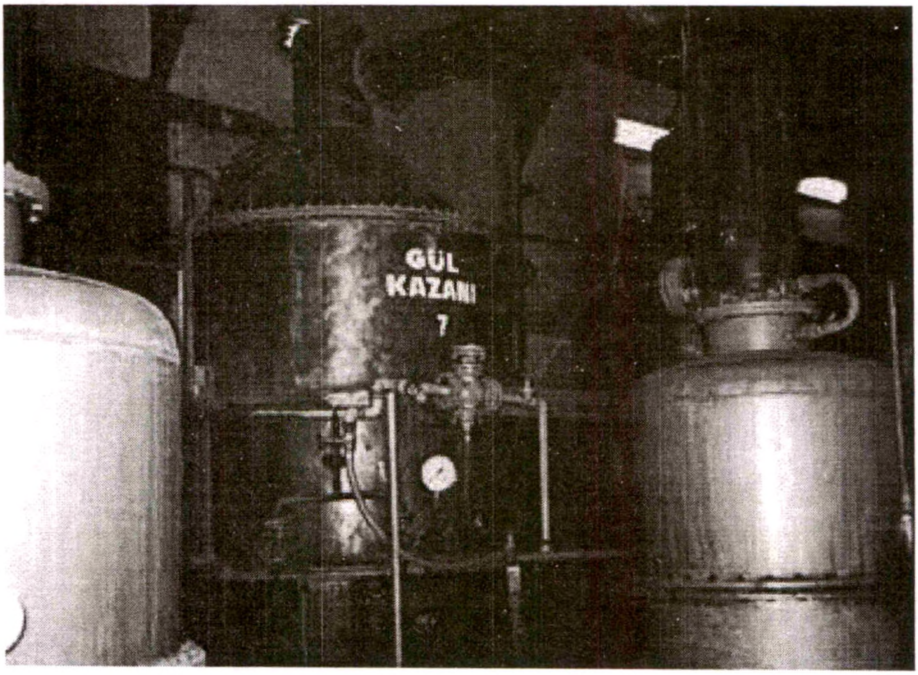
- Off-season cut flower production
- Loose flowers
- Planting material production
- Potted plants
- Annual flower seed production
- Perfume and oil extraction
- Specialty cut flowers
- Cut greens
- Rooted cuttings
- Bonsai production from wild plants
- Drying of flowers
- Plant rental service

Extraction of Essential Oil from Aromatic Plants :

The essential oils are usually complex mixtures of organic chemicals like monoterpenes, sesquiterpenes and benzene derivatives.

The extraction of essential oil is done at domestic/farm level as cottage industry. Simple distillation processes are practiced for extraction of essential oil from the aromatic plants.

Processes of Oil Extraction :



Water Distillation Method

- In this method, the material is in contact with a large amount of boiling water where It may either float or completely immerse leaving sufficient space for vapour. The still distillation is heated by direct fire.

Advantages :

- Water distillation process is simple.
- Requires less investment.
- Widely used throughout the world.
- The materials which agglutinate in contact with steam can easily be processed by this method.
- Suitable for finely divided materials, herbs and grasses.

Disadvantages :

- The process is not economical.
- It requires more fuel and labour.
- High boiling point and water soluble oil constituents are not completely vapourised and remain dissolved in water.
- It has a slow turnover.
- The control is difficult and rate of distillation is variable.
- The rate of distillation and the yield of oil are low.
- Hydrolysis is much more than in other processes.

Water and Steam Distillation :

This is the more popular method among small producers. The smaller units are heated by direct fire and larger ones by steam jacket or closed steam coil. In this process the charge is kept over a false bottom and out of contact with boiling water.

Advantages : Chances of decomposition products in oil by hydrolysis, polymerization of resinification are less. It requires less time and less fuel for distillation and yields more oil.

Disadvantages: Oils of high boiling points require long hours of distillation.

Steam Distillation :

In this method steam is injected into the still. During distillation the temperature of charge rises to the temperature of boiling water.

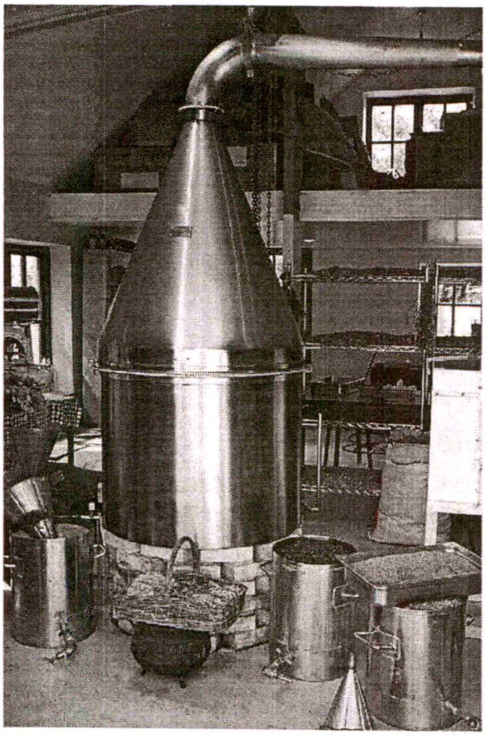


FIG: Photograph of a steam distillation unit used at the Burren Perfumery, Ireland.

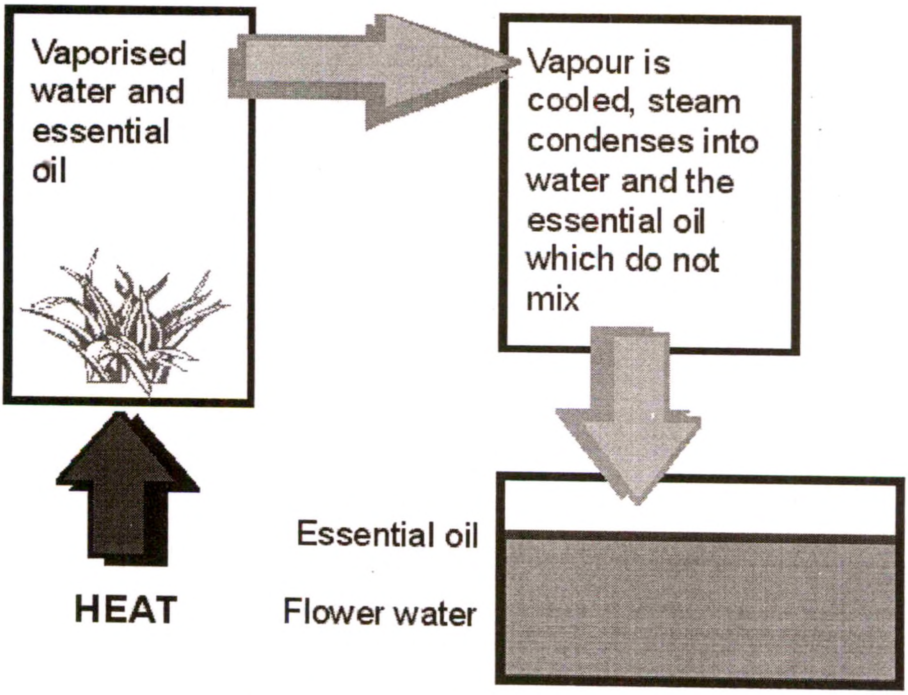

Vaporised water and essential oil
Vapour is cooled, steam condenses into water and the essential oil which do not mix
HEAT
Essential oil
Flower water

FIG: Principles of steam distillation

Advantages : The process excels water distillation and water & steam distillation methods as regards to cost, rate of distillation, capacity of production and quality of oil distilled.

Name	**Constituents :**
Rose	Citronellol, Geraniol, Nerol, Farnesol, Esters, Rose Oxide, Limonene, Myrcene, Pinene Lavender Linalyl Acetate, Linalol, Terpinenol, Cineole, BetaCaryophyllene, Farnascene
Jasmine	Benzyl zcetate, Linalool, Benzyl alcohol, Indole, Benzyl benzoate, Cis-jasmone, Geraniol, Methyl Anthranilate, P-cresol, Farnesol, Cis-3-hexenyl benzoate, Eugenol, Nerol, Ceosol, Benzoic acid, Benzaldehyde, Y-terpineol, Nerolidol, Isophytol, Phytol.
Marigold	Tagetones, Ocimene, Myrcene, Linalool, Limonene, Pinenes, Carvone, Citral, Camphene, Valeric acid, Salicylaldehyde.
Tuberose	Methyl benzoate, Methyl anthranilate, Benzyl alcohol, Butyric acid, Eugenol, Nerol, Farnesol, Geraniol.
Chamomile	Bisabolol, Farnesol, Azulene, Farnasene, Thujanol Clary sage Linalol, Sclareol, Myrcene, Phellandrene, Pinene
Clove	Eugenol, Eugenyl acetate, Caryophyllene, Isocaryophyllene.
Hyssop	Pinocamphone, Pinene, Borneol, Geraniol, Thujone.
Camphene	Limonene, Phellandrene
Geranium	Citronellol, Geraniol, Citronellyl Acetate, Geranyl Acetate, Linalyl Acetate, Beta-Caryophyllene Orange Limonene, myrcene, camphene, pinene, ocimene,cymene.
Manuka	Marjoram Alpha-Terpineol, Terpinen-4-ol, Sabinene, Linalol,
Sabinol	Thujanol, Citral, Linalyl Acetate, Camphor,
Carvacrol	Estragol, Eugenol, Myrcene, Phellandrene,
Pinene	Alpha Terpenene, Beta-Caryophyllene Ylang-ylang Linalol, Farnesol, Geraniol, Geranial, Benzyl Acetate, Geranyl Acetate, Eugenol, Methyl Chavicol, Pinene*Beta-Caryophyllene, Farnasene
Osmanthus	Linolenic acid, Linoleic acid, Palmitic acid, beta-Ionone,

Use of Essential Oils in Aromatherapy :

The word "Aromatherapy" literally means therapy through aroma, without specifying the source of the aroma. But, aromatherapy in practice is only essential oils, and no other form of aroma. It should be emphasized, however, that aromatic materials are powerful therapeutic agents, and should always be used in moderation. Different oils have different uses. However, a brief description is given in the table below—

Name of the Oil Uses :

Rose : Depression, Eczema, Frigidity, Mature Skin, Menopause, Stress.

Lavender : Acne, Allergies, Anxiety, Asthma, Athlete's foot, Bruises, Burns, Chicken pox, Colic, Cuts, Cystitis, Depression, Dermatitis, Dysmenorrhea, Earache, Flatulence, Headache, Hypertension, Insect bites, Insect repellant, Itching, Labor pains, Migrane, Oily skin, Rheumatism, Scabies, Scars, Sores, Sprains, Strains, Stress, Stretch marks, Vertigo, Whooping cough.

Jasmine : Depression, Dry skin, Exhaustion, Labor pains, Sensitive skin.

Marigold : Corns, Warts.

Tuberose : Used primarily in perfumery and aromatics.

Chamomile : Abscesses, Allergies, Arthritis, Boils, Colic, Cuts, Cystitis, Dermatitis, Dysmenorrhea, Earache, Flatulence, Hair, Headache, Inflamed skin, Insect bites, Insomnia, Nausea, Neuralgia, PMS, Rheumatism, Sores, Sprains, Strains,

Eugenol : Stress, Wounds.

Clary sage : Amenorrhea, Asthma, Coughing, Dysmenorrhea, Exhaustion, Gas, Labor pains, Sore throat, Stress.

Clove : Arthritis, Asthma, Bronchitis, Rheumatism, Sprains, Strains, Toothache.

Hyssop : Bruises, Coughing, Sore throat.

Geranium : Acne, Cellulites, Dull skin, Lice, Menopause, Oily skin.

Orange : Colds, Constipation, Dull skin, Flatulence, Flatulence, Flu, Gums, Mouth, Slow digestion, Stress.

Manuka : Acne, Athlete's foot, Candida, Chicken pox, Cold sores, Colds, Corns, Cuts, Flu, Insect bites, Itching, Migraine, Oily skin, Ringworm, Sinusitis, Sores, Spots, Urethritis, Warts, Whooping cough.

Marjoram : Aching muscles, Amenorrhea, Bronchitis, Chiliblains, Colic, Coughing, Excessive sex drive, Flatulence, Hypertension, Muscle cramps, Neuralgia, Rheumatism, Sprains, Strains, Stress, Ticks.

Ylang-ylang : Anxiety, Depression, Frigidity, Hypertension, Palpitations, Stress.

Osmanthus : An additive for tea and other beverages

Analysis of Essential Oils :

- Oils are tested in four stages –
- Sensory evaluation in which the smell, viscosity, color and clarity of the oil are assessed.
- Odor/smell test, which helps to determine if oil is really what it is claimed to be, since certain adulterants can be identified by this test.

- Physical parameters such as specific gravity, optical rotation and refractive index are determined.
- GC-MS evaluation.

Value addition in essential oils :

- Value addition in essential oils is performed by two methods–

1. Separation of constituents—The value addition in essential oils by separation of constituents is being carried out through fractional distillation.
2. Chemical conversion—The value addition in essential oils by chemical conversion is carried out with the help of chemicals either in presence of catalyst or otherwise.

Examples of value addition in essential oils :

- Citronellal to Citronellol
  Hydroxycitronellal
  Cetronellyl Nitrile
- Citronellol to Citronellyl Formate
- Geraniol to Geranyl Acetate
  Geranyl Framate
  Geranyl Butarate
  Geranyl Propionate
- Specific Flower Fragrances
- Although many flowers are fragrant, some flowers gained popularity because of their having exceptionally fragrances. Some of those flowers with high fragrances, infact unique fragrances are dealt with here.

Rose :

One of the most valuable elements of a fine perfume is provided by the rose known as the "queen of flowers". Rose perfumes were very popular with the Romans and the Greeks. Rose flowers are gathered at night since they carry fragrance before sunrise. The two main species of roses used in perfume are the *Rosa centifolia*, found in the South of France, and the *Rosa damascena* (Damask Rose) located primarily in Arab countries. The damask rose is most widely grown for perfumery.

Violets :

Violets have been used in perfumes throughout the ages because of their varied fragrances. They used in both perfumes and medicines. There are two varieties of violets most commonly used in perfumes, the Victoria Violet and the Parma Violet. Violets only produce a scant amount of essential oils, and are rarely used today. A synthetic replacement for violet is most commonly used, along with other essential oils resembling the violet.

Jasmine :

Jasmine, another "absolute or pure essence, gives a perfume a well-rounded, finished quality. Jasmine flowers are harvested when their fragrance is at its peak just before dawn. The flowers must be processed immediately before their freshness and fragrances fade away. The jasmine must also be placed in special baskets to prevent the flowers from bruising, and unbalancing the flower's natural bouquet.

Lily :

The (Lillium) is a hearty bulb that can be planted in fall or spring. In the whole lily spectrum, there is something for everyone, from easy-to-grow, long-lived garden plants to the more difficult and rare species. Their summer blooms are the highlight of the garden, and they are long-lasting as cut flowers. Most lilies bloom between June and August, and the large, trumpet shaped flower feature a variety of colors, designs and fragrances.

- **Below given is a list of some such flowers with great and lovely fragrances—**
  - Chamomile
  - Lavender
  - Nicotiana
  - Sweet Pea
  - Chocolate Flower
  - Magnolia
  - Rosemary
  - Wallflower
  - Clary Sage
  - Moonflower
  - Stock flower

Conclusion :

Floriculture in India is being viewed as a high growth Industry. Commercial floriculture is becoming important from the export angle. The government of India offers tax benefits to new export oriented floriculture companies in the form of income-tax holidays and exemption from certain import duties. Agricultural and Processed Food Products Export Development Authority (APEDA), responsible for export promotion and development of floriculture in India, grants subsidies for establishing cold storage, pre cooling units, refrigerated vans and green houses, and air freight subsidy to exports. Among the various components of floriculture industry the essential oil extraction is an important one. The plant based pharmaceuticals, herbal medicines, perfumery, cosmetics, fragrances and food flavour industries have recorded a phenomenal expansion in last 50 years and as a result, this sector figures in high annual growth rate industries in agri-business. The market for plant based pharmaceuticals in the year 1994 was estimated to range between US$ 32-43 billion. The world essential oil production at raw materials level was estimated to be about Rs. 32 billion of which 55-60% goes to food flavours and 15-20% as fragrances. So there are lots of opportunities to explore and work in this sector.

WEST BENGAL FLORICULTURE–THE ROAD AHEAD

A. Bhattacharyya

Preamble :

Floriculture is the aesthetic branch of horticulture, that deals with the cultivation of ornamental annuals, biennials, perennials and potted plants like house plants, cacti and succulents, production of their economic products like scents, oils and medicines etc., manufacture of by-products like dry flowers, cut foliages, flower and foliage arrangements, application of biotechnological approaches like micro-popagation, somatic hybridization and genetic engineering for obtaining new flowers of better quality and form and also their domestic marketing and export.

Why Floriculture

Environmental planning of urban and rural areas for overcoming pollution, social and rural forestry, wasteland development, afforestation, outdoor and indoor landscaping are the needs of the present word. The role of ornamental plants in this arena is very important from the perspective of following:

i. Changes in social value of people.
ii. Changes in socio-economic structure.
iii. Development of hotel based industries.
iv. Establishment of small flats in urban areas often termed as 'Pigeon's Nest' is another
v. Modern contribution to the urbanization.
vi. To get a touch of the environment, people want to use more and more house plants for interior decoration. Decoration of offices of the corporate sectors with potted plants facilitates and scope of plant rental services.

The Floriculture Industry :

The Floriculture industry comprises production and marketing of both traditional and non-traditional cut-flowers and cut-foliages in fresh condition. The dried products of both flower and foliage. Production of floristry items like bouquets, flower baskets, buttonholes, flower arrangements, floral ornaments (floral crown, bangles, garlands, wreaths etc.), flower chains for decoration of houses and vehicles required in different occasions. Loose flowers of different types are used for hair decorations. The plant nursery for propagation and supply of plants, seeds, bulbs, corms and other propagating materials. Production and supply of tissue culture/micropropagated plants. Plant rental service for supply of house plants on annual rent for a specific period. Extraction of essential oils from flowers and preparation of gulkand and pot-pourries etc.

World Scenario :

The value of total world trade of floricultural products was more the US$ 6800 million. In 1995, of which, India's share was only 0.3%. The largest import market of cut-flowers in the world is Germany where as Netherland is the leading exporter with an estimated share of 64% consisting of a production value of US $3588 mil. Out of the total world production value of US $20891 million. In the other flower category Netherland is also considered as the number one supplier to the European Union. Netherland is also the leading exporter of flower bulbs and nursery stocks.

The per capita consumption of cut flowers and plants was highest in Norway (US $146) followed by Switzerland (US $128), Germany (US $88), Denmark (US $84) etc. Highest consumption was found with USA (US $12500 million).

Aalsmeer at Netherland is the leading flower auction market in the world and Agresco of Israel is another export market agency for Asian Countries. At Warsaw there is another important international flower market.

Floriculture in India :

India has a long tradition of floriculture. References to flowers and gardens are found in most of our ancient classic literature, like the Vedas, Ramayana, Mahabharata, etc. Depiction of flowers and garden in ancient paintings, murals, coins, etc. was common. All these give an idea of the close association of floriculture with our life and culture. In the present times too, flowers are used at all our social, cultural and religions occasions. In spite of this long and close association with floriculture, records of commercial activity related to this area are very few. It has, generally, been regarded as a gardening activity related to growing of flowers for its aesthetic importance of beautifying the environment. It is perhaps in the present century only, that with changing life-styles and increased urban affluence, floriculture has assumed a definite commercial status. During the last 2-3 decades, particularly, appreciation of the potential of commercial floriculture has resulted in the blossoming of this field into a viable agribusiness option. Availability of natural resources, like diverse agro climatic conditions, permit.

Status of India in Floriculture :

In India the idea about floriculture as a commercially viable enterprise besides its uses in the worship is germinated a long before, mainly-because of varied types of agro climatic conditions favorable for growing a wide range of ornamental plants throughout the years with a background of long heritage of ornamental horticulture which is evident from the ancient literature like

Ramayana, Mahabharata, Vedic literatures, Upanisads and works of Kalidasa. The flowers from those periods have been associated in social life and are used for varied purposes such as worship, decoration on auspicious ceremonies, preparation of perfumes, floristry and flower arrangements. With the increasing popularity of ornamental plants in the National and International Market, organized research was initiated by the Indian Institute of Horticultural Research, Bangalore way back in 1963. Scientists of IARI, New Delhi have sent a trial consignment of rose with the assistance of State Trading Corporation in 1969 because of the competitive advantage of low cost of labour, tropical and sub-tropical climate for production of flowers specially during winter.

Floricultural Research :

Started with the establishment of Agricultural Universities. These universities with support of Indian Council of Agricultural Research through All India Co-ordinated Floriculture Improvement Project started functioning in 1970-71. Different Institutes and Universities are concentrating their work on different crops. Marked development in floriculture have been noticed in last 30 years and mainly because of availability of cut rose, carnation, gladiolus, chrysanthemum, tuberose, orchids, marigold, lilies, hibiscus, anthurium, gerbera has increased in different important cities and major towns of the country. The domestic Indian market is unorganized. Information sources regarding floricultural production and area under cultivation are not adequate and updated. The available figure under cultivation of floricultural.

Cultivation of Flowers in West Bengal : Peresent Scenario :

As stated, the present area under flowers in West Bengal is estimated to be in the range of ten to twelve thousand hectare. The present total production of flowers is estimated at sixty to sixty five thousand metric tonnes at a productivity of 6000 kgs or 6 tonnes per hectare. The number of flower growers is about forty to forty two thousand.

Market and Auction Centres in West Bengal :

As already stated the majority of the growth centres are in rural areas of Midnapore, Nadia, Hooghly, Howrah and 24 pgs. Some of which have primary markets but majority of the growers have to take their produce to the Mallickghat flower market at Calcutta.

Government felt the need of establishing an auction-cum-market Centre at Panskura in Midnapore and also some other areas if suitable initiatives are shown by the concerned Panchayats of local bodies.

In recent times West Bengal under the dept of FPI & H has been given thrust on horticulture especially floriculture development & substantial fund has also been released by govt of India. In order to fulfill the "WEST BENGAL FLORICULTURE–THE ROAD AHEAD" some of the positive actions has also been taken some of these are furnished.

FLOWER ZONES

- Kalimpong—Siliguri
- 24-parganas (North)
- Kharagpur—Jhargram
- Amtala—Baruipur
- Asansol—Durgapur
- Kolaghat—Panskura
- Ranaghat—Nabadwip

Besides, Howrah, Hooghly, Birbhum, Bankura, Purulia and Murshidabad are also coming up fast in flower cultivation.

- Kalimpong—Siliguri : Orchid, Lily, Gerbera etc.
- Assansol—Durgapur : Gerbera, Rose, Marigold etc.
- North 24 Pgs. : Marigold, Tuberose etc.
- Kolaghat—Panskura : Marigold, Jasmine, Cockscomb, Rose, gladiolus etc.
- Kharagpur—Jhargram : Rose (Nursery)
- Ranaghat—Nabadwip : Tuberose, Marigold etc.
- Amtala—Baruipur : Ornamental

DISTRICT	**AREA (ha)**	**PRODUCTION**		**% SHARE IN**
		('000 MT)	**Spike/Buds (Crore)**	**STATE AREA**
DARJEELING	1156	0.244	17.033	6.67
UTTAR DINAJPUR	28	0.244		0.16
MALDA	60	0.377		0.34
MURSHIDABAD	100	0.54		0.58
NADIA	5100	14.653	21.81	29.42
NORTH 24 PGS	965	2.068	7.134	5.56
SOUTH 24 PGS	340	1.292	1.612	1.96
HOWRAH	1458	4.039	7.68	8.41
HOOGHLY	574	0.503	3.709	3.31
BURDWAN	59	0.31		0.34
BIRBHUM	85	0.336	0.48	0.49
PASCHIM MEDINIPUR	2224	6.144	6.608	12.83
PURBA MEDINIPUR	5114	12.32	20.49	29.51

FLOWER	AREA ('000 ha)	PRODUCTION	
		MT	Spike/Buds (Crore)
ROSE	1.245		16.199
CHRYSANTHEMUM	0.357	0.441	
GLADIOLUS	1.725		24.586
TUBEROSE	2.535		40.886
MARIGOLD	3.748	30.06	
JASMINE	0.427	0.569	
SEASONAL	4.071	6.594	
MISC. FLOWER	2.07	1.807	

CROP	BCR
Rose	2.33
Gladiolus	1.94
Tuberose	2.06
Jasmine	1.50
Anthurium (Low Cost)	3.54
Cymbidium (Low Cost)	1.52
Cactus	1.22
Lily	2.41

Swot Analysis :

- Strength : Varied Climate & Soil
  Airport Facilities & Strategic
  Position For International Market
  Concentrated Area
  Skilled Manpower
- Weakness : Quality Planting Mat.
  Small Land Holding
  Sustenance Farming
  Lack of Hi-Tech Cultn
- Opportunity : High Domestic & Int. Demand
  Organic Production
- Threat : Lack of Awareness of Export Standard
  Inconsistent Export

Flowers Exported From The State :

Flower	Destination	Av. Volume
Tuberose	Holland	10000 Stem/Week
Gladiolus	Sharjah	2000 Stem/Week
Rose, Gerbera, Carnation, Cockscomb	London	2000 Stem/Week

Swot Analysis :

♦ Strength :	Varied Climate & Soil Airport Facilities & Strategic Position For International Market Concentrated Area Skilled Manpower
♦ Weakness :	Quality Planting Mat. Small Land Holding Sustenance Farming Lack of Hi-Tech Cultn.
♦ Opportunity :	High Domestic & Int. Demand Organic Production
♦ Threat :	Lack of Awareness of Export Standard Inconsistent Export

State Initiatives :

A. Macro Mode

- Area Expansion – Normal
- Use of Shade Net
- Area Expansion – Hi-Tech
- Awareness Programme

B. National Horticulture Mission

- Area Expansion
- Awareness Programme
- Market Development
- Protected Cultivation
- Post Harvest Management

C. Micro Irrigation

- Drip
- Sprinkler

D. Research Promotion

E. Proposal For AEZ For Floriculture

F. Market Complex—Mallikghat & Panskura

G. Proposed Market Complex—Ranaghat, Mungpoo, Baruipur

H. Export Through WBSFP & HDCL.

ORCHID CULTIVATION AND MANAGEMENT

Banasri Das and Gopal Malla

Introduction :

Orchids are known for their lovely blooms in various brilliant colors, curious shape and long lasting flower quality. India with its vast geographic area and varied climatic condition is very much congenial of successful cultivation of commercial orchid flowers and also treasure house of plant genetic resources. India is considered as one of the mega-biodiversity regions in the world with two major biodiversity hot-spots, the Eastern Himalayas and Western Ghats. These hot spots are known for the rich occurrence of diverse flora especially the orchids.

Orchids are highly priced and occupy 8% of the global floral trade. Among the various genera cymbidium has the highest demand. Commercial cultivation of orchid is a profitable business and thus flourishing locally and globally.

Origin and Distribution :

Orchids were cultivated even in 500 BC. 'IAN' was the name, for orchid used in Chinese ancient literature as found in the "Eki Kyo" of which Confucius (551-479 BC) was a coauthor. The ancient Greeks were the first to take note of this strange plant in the period of 370 to 285 BC. Orchids occur in sea level and up to, an altitude of 4000m above mean sea level. Orchids are abundant in the Southeast Asia, Central America and South Africa. They are also distributed in China, Japan, Philippines, Europe and Australia (Rao 1979). India is very rich in orchids flora and the major areas are the Eastern Himalayas, western and South Indian Hills, and forms 9% of flora and nearly 1700 species belonging 200 genera. There are about 60 genera and 200 species of orchids in Kerala. Common Indian genera include, *Dendrobium, Bulbophyllum, Coelogym Cymbidium, Habenaria, and Liporis etc.*

Though orchids were cultivated in very early age but its transformation from hobby to commercial cultivation was very slow. John Lindlay first suggested cultural schedule for orchids in 1830. Among the several researchers successful scientific research by Knudson (1922) and Morel (1964) resulted in perfecting a method of multiplication of orchids in glass flasks. By this time the requirements for the successful orchid cultivation could also be standardized.

Classification of Orchids :

Family Orchidaceae is the largest among the flowering plants and classificaiton of the same has been attempted by a large number of orchidologist and botanist for the last two centuries in the world. An important and simplified classification was done by botanist Linnaeus (1953) and Bechtel et al (1992). In the year 1990, however the whole family was divided into five subfamilies and placed the tribes under these subfamilies which are the simplest classification.

Family—	Orchidaceae
Subfamily—	Apostaiodeae Cypridiodeae Spiranthoideae Orchidodeae Epidendroideae

Types of Commercial Orchids :

Commercially cultivated orchids are divided mainly in two groups on the basis of the structure :

1. Monopodials—They grows from a single vegetative apex, do not have rhizome, pseudobulbs and they are climbers.
2. Sympodials—They have rhizome or modified bulbs and grow from number of vegetative apices.

Orchids can be divided into five types on the basis of their habit.

1. Terrestrial
2. Epiphytes
3. Lithophytes
4. Saprophytes
5. Subterranean

Production and Global Market :

Orchid, a most beloved and pampered flower with its long lasting characteristics occupy prime position in the cut flower industry. The annual growth of the market of orchid cut flowers industry is very promising (10-20%). Within a very short span of 50 years orchid cut flower reached a prominent position in world trade market. World orchid trade is estimated to be around US $44 billion (Pradhan 2001), where Thailand alone trades US $26 million (Upadhaya and Das 2003). In USA potted blooming orchids registered a turn over of US $79 million in 1999. India contributes <1% of the total global flower market.

Climatic Requirements :

Orchids are broadly classified depending on the climatic zones which they choose to grow. Accordingly three different types of orchids with different climatic zones have been recognized in India.

1. Tropical zone	300 to 900 m above mean sea level
2. Subtropical zone	900 to 1800 m above mean sea level
3. Temperate zone	1800 to 3500 m above mean sea level

Sunlight has several photo morphologic influences upon plants such as inducing photosynthesis, phototropism and photoperiodism. The optimum sunlight which orchids generally require is between 3000 to 6000 foot candles. Therefore it becomes necessary to shade some orchid greenhouses to ensure that the proper amount of light will be available for good plant growth. During bright sunny days 50% shade net is retained to allow ideal range of light and bottom 25% shade is rolled back. Even though the various species vary in their requirement of optimum temperature, generally orchids thrive in a day temperature varying between 16°C to 21°C and a night temperature of 19°C to 30°C, if plants are grown beyond the tolerance limit results poor growth and even terminating to death. Temperature influences not only proper vegetative growth but also production of flowers in quite a good number of species. Most *Cymbidium* species need a temperature of 13°C to 16°C during nights and plenty of sunlight during day time for proper flowering.

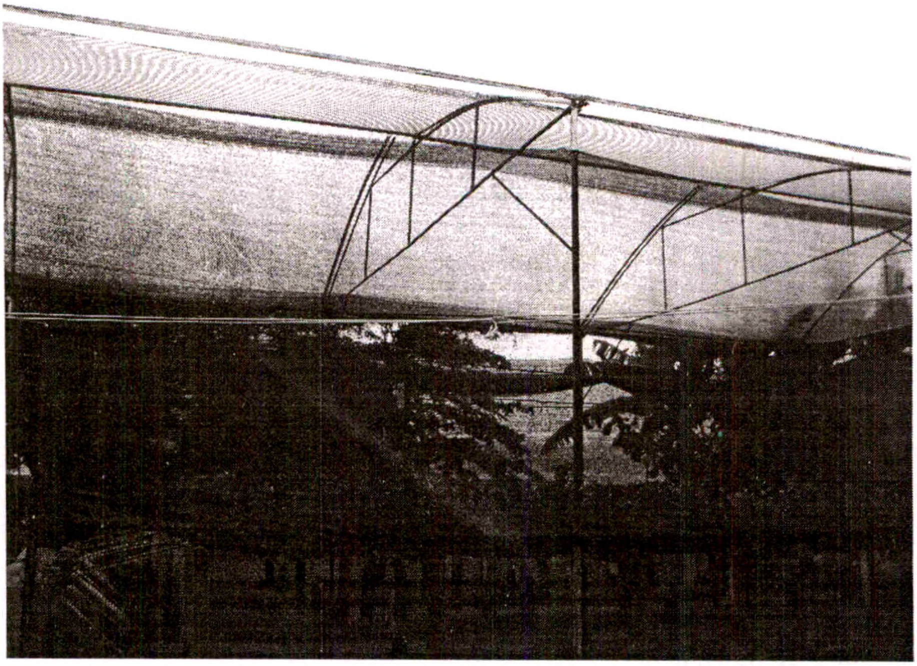


FIG : A shed net House of Orchid for maintenance of required micro climate

Temperature requirements for the Different Orchids :

Category	Part of the day	Temperature range	Orchids
Cool Species	Summer : Day	16° - 21°C	*Cymbidium*
	Night	13°C	*Odontoglossum*
	Winter : Day	13° - 16°C	*Paphiopadilums*
Intermediate Species	Summer : Day	18° - 24°C	*Cattleyas*
	Night	16° - 18°C	*Oncidiums*
	Winter : Day	16° - 21°C	*Dendrobiums*
	Night	13° - 16°C	
Warm Species	Summer : Day	21° - 29°C	*Phalaenopsis*
	Night	18° - 21°C	Ever Green
	Winter : Day	21° - 29°C	*Dendrobium*
	Night	18° - 22°C	

Humidity is very important for the good growth of all plants, especially tropical orchids and particularly epiphytes. Relative humidity above 50% is suitable for most orchids. Excessive humidity is dangerous, for it brings about susceptibility to certain disease.

Containers :

For the naturally growing orchid the free trunks, ground, damp broken walls, and rocks are the containers. But when orchids are grown commercially, growers use special types of containers well suited for their habitat. Some of the most popular containers presently used by the tropical orchid growers are pots, baskets, wooden logs, tree ferns and coconut husks etc.

Clay pots are generally preferred over plastic pots. They may have few to many holes, for good drainage and aeration. The pot size may vary from thumb size to 20 inches pots depending on the size of the plants planted in the pots. The advantage of baskets are that air can enter from all directions, but this can lead to a rapid drying out of the compost, especially in hot summer spells, and therefore watering is more of a chore with them. Recently, a new coconut basket introduced called the coco nest.

Substrate Dynamics :

Orchids require an organic well-aerated medium with good water retentive quality. An ideal medium for pot and ground planting should have the following properties :

i. Good water holding capacity.
ii. High porosity.

iii. Good aeration.
iv. Low salt concentration.
v. Must provide good anchorage.
vi. Good structure and texture.

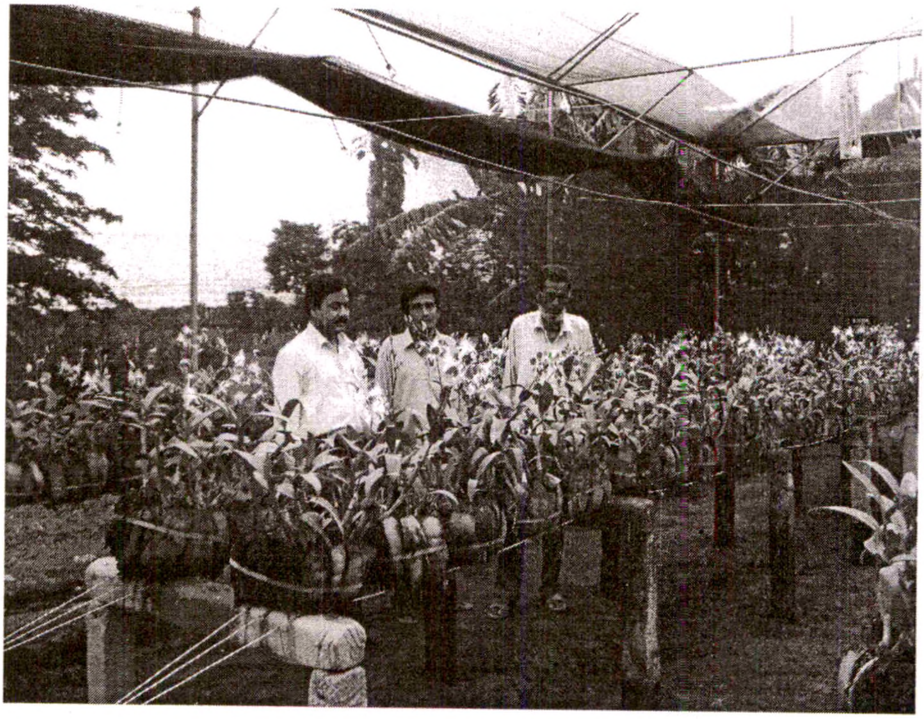


FIG : Cultivation of dendrobium orchid in North East

Following natural derivatives which satisfy the above conditions were tried to grow tropical orchids commercially :

i. Saw dust.
ii. Tree bark.
iii. Groundnut shells.
iv. Cocopeat.
v. Wood shavings.
vi. Brick, gravel, rubble etc.
vii. Coconut shells.
viii. Charcoal.

At present coconut husk and cocopeat have become the most popular media for orchid cultivation. An ideal cocopeat should have the following standards for growing horticultural crops.

i. Ph 7.0
ii. Ec 0.5 ms/cm
iii. Potassium 2.0 Mmol/lit
iv. Sodium 2.0 Mmol/lit
v. Chlorine 2.0 Mmol/lit
vi. Iron 1.0 micromol/lit
vii. Zinc 3.0 micromol/lit
viii. Boron 1.5 micromol/lit
ix. Copper 1.0 micromol/lit

Repotting :

Without compelling reasons orchid should not be repotted. If however aeration of the potting material is poor because of the composition it must be replaced. The repotting schedule of some of the orchid include :

i. Annual repotting—*Calenthe, Dendrobium, Phalaenopsis*, and its hybrids *Paphiopedium*.
ii. Every other year—*Cattleya, Dendrobium, Oncidium.*
iii. Every third year—*Vanda* and its allies.

Repotting times do not vary very much but should usually be at the beginning of the active growing season or at least when the new roots appear. To remove the root ball from the pot it is advisable to use a knife. All old potting materials dead roots and shriveled pseudobulbs have to be removed.

Watering :

Good quality water is very important requirement to grow orchids successfully. Watering needs depend on the potting media and the growing condition. Correct watering has a direct relationship between atmospheric and compost mixture. A potting media should never be wet but just evenly moist. Terrestrial orchids require more water than epiphytes. The water requirement of *Dendrobium* orchid is met by misting the green house at least thrice during hot days so as to encourage the aerial roots to take up the water required by the plants. Plants, which are freshly potted should be watered very sparingly till new roots appear. Wrinkling of the pseudobulps and yellowing of the leaves are sure signs of excessive watering.

The quantity of water used whether it is for spraying and damping down or watering direct is of great importance. Since tap water has usually been chemically treated it should be used with caution. The temperature of the water is important if the water temperature and the surrounding air temperature is different no harm will result and healthy plants can tolerate slight difference either way.

Water Quality requirement for Orchid :

Water quality	E.C. (M mol/lit)	Sodium (M mol/lit)	Chlorine (M mol/lit)	Bicarbonate (M mol/lit)	Calcium (M mol/lit)
Good	<0.5	<1.0	<1.0	<0.5	<1.0
Acceptable	0.5-1.0	1.0-3.0	1.0-3.0	0.5-1.0	1.0-2.0
Bad	>1.0	>0.3	>3.0	>1.0	>2.0

Propagation :

There are three main methods of increasing orchid plants : Vegetatively, i.e. by dividing large plants i.e. by removing offsets and plantlets, micropropagation i.e. by growing and dividing small growing tissues in culture media and by seed.

The creation of hybrids and raising the seedlings in flasks are used by commercial growers throughout the world. Plants raised from seed however take long time to bloom the technique of meristem culture is used for rapid and large scale multiplication.

Nutrient Management :

Three basic principles apply to orchid nutrition.

1. Only well rooted plants should be fertilized.
2. The fertilizer should preferably be given in small but frequent doses.
3. It should only be applied during the period of maximum active growth.

The actual fertilizer can be organic or inorganic. When the vegetative growth begins (early April) mix fertilizer in the irrigation water to a level of 2.0 milli sciemens and water every time with this solution. There are several commercial organic feeds in the market and many of these are good for orchids, especially those prepared from fish or seaweed bases. Furthermore cow dung slurry is often used as an organic supplement to *Dendrobium* plants when grows in beds.

With inorganic feeding the exact proportions of the different chemicals can be accurately ascertained and the plants feed according to their requirements. The essential elements are Nitrogen(N), Phosphorous(P) and Potassium(K), the NPK mixture fertilizer 20N, 20P and 20K is mainly responsible for the control of growth and development. Different nutrients mixed together and dissolved in 4.5 litre of water.

1. Potassium Nitrate 2.63 g
2. Ammonium Sulphate 0.44 g

3. Manganese Sulphate 2.04 g
4. Monocalcium Phosphate 1.00 g
5. Calcium Sulphate 4.86 g
6. Iron Sulphate 0.50 g
7. Manganese Sulphate 0.25 g

Diseases and Pests :

Orchids are also attacked like other cultivated plants by a number of pests and diseases. Most of the diseases are infectious and spread from plant to plant. Fungi, bacteria and viruses infect orchids causing various diseases. In general orchids are quite hardy and less labile than other indoor plants to catch disease or attract pests. The most common orchid diseases are leaf spot, pythium, black rot, heart rot, root rot, bacterial brown rot, orchid wilt, bacterial soft rot and viral diseases. High humidity, cool temperature and standing water favour all most all fungi diseases of orchids. In general, fungal diseases can be controlled/checked with the following measures—

- Remove infected parts. Cut 2.5 cm with healthy tissue and seal cuts with fungicides like carbendazim, mancozeb, hexaconazole etc.
- Reduce humidity and increase air circulation.
- Regular inspection of the field.

The bacterial diseases could be suppressed by using antibiotics like agrimycin, tetracycline, streptomycin etc.

At least 25 viruses have been identified from orchids. Important insect pests of orchids are aphids, mealy bugs, scales, slugs of snails, spiders, mites etc. which can be controlled by adopting the following methods such as cultural methods, biological methods and chemical methods.

Harvesting :

Orchids exhibit an extended juvenile phase ranging between 2-6 years depending on the species even though they are not woody as in the case of trees. Generally the orchids start following from the second year onwards when propagated through stem cutting. They attain maturity in 3 years when propagated through off shoots and flowers from 4th year onwards when tissue cultured plants are used as the planting materials though proper management has a crucial effect on flowering.

Proper time, stage and method of harvest determine the quality of the produce. In general, orchid flowers do not mature until 3-4 days after they open. Harvesting should preferably be done in the evening. All the tools should be sterilized. Flower harvested in the heat of the day can be stressed because of high temperature. The *Dendrobium* is harvested when the 3/4th of the spike buds show colour.

On an average the plant produces 2-3 marketable spikes in the second year and produces 5-6 spikes from the third year onwards.

Grading is one of the important post harvest handling. It is done mainly on length of the flower spike, flower number and size and arrangement of the flowers on the spike.

Since most orchid flowers are long lived on the plants they shoulder not be harvested until needed. The tropical orchids have to be stored at 13°C till they are transported.

Packing is another important aspect in the flower trade. If it is not done properly, the flower may whither or suffer mechanical injury during transit. For proper packing different sizes of boxes are used.

Box LL	:	37×100×46 cm
Box L	:	38×87×44 cm
Box M	:	37×75×46 cm
Box MF	:	37×75×38 cm

Orchids flowers are packed in the boxes make of cardboard and polythene windows for retail distribution.

Some Addresses of Distributers, Dealers and Producers of Commercial Orchids are as Below :

1. **Airbridge Greens**

   Address : Ichapur, Kamardanga, Howrah, West Bengal-711 104, India
   Phone : +(91)-(33)-26771449/26773189/26677208
   Fax : +(91)-(33)-26770902,
   Cell Phone : +(91)-9830162117/9638824011
   Website : http://www.indiamart.com/airbridge/agrobioproducts.html

2. **Kissan Flowers**

   Address : 379, Khari Baoli, New Delhi, Delhi–110 006, India
   Phone : +(91)-(11)-65357672,
   Cell Phone : +(91)-9810532001
   Website : http://www.indiamart.com/kissanflowers/ornamental-orchids.html

3. **Kissanphool & Co.**

   Address : 379, Khari Baoli, Delhi, Delhi–110 006, India
   Phone : +(91)-(11)-23975013/25910737
   Cell Phone : +(91)-9810060670/9312219379
   Website : http://www.indiamart.com/kissanphoolandcompany.

4. **Marubi Orchids Centre Private Limited**

Address : 4, Synagogue Street, 8th Floor, Room No. 808, Kolkata,
West Bengal–700 001, India
Phone : +(91)-(33)-64505494, Fax : +(91)-(33)-22428444
Cell Phone : +(91)-9830559643
Website : http://www.indiamart.com/marubi/flowers.html

5. **Agri Unlimited**

Adress : 39/3, 16th Cross, 2nd Main, Sampangiram Nagar, Bengaluru,
Karnataka–560 027, India
Phone : +(91)-(80)-41142524 Fax : +(91)-(80)-41142524
Cell Phone : +(91)-9448478514
Website : http://www.agriunlimited.com/tissue-culture-plants.html

6. **Aayesha Agro Traders**

Address : Navazish Park, F2 Chawl, R. No. Gali No. 11 Kondwa, Pune,
Maharashtra–411 001, India
Cell Phone : +(91)-9921760257
Website : http://www.indiamart.com/aayeshaagrotraders.

7. **IFAB Limited**

Address : K.A.I.C. Premises, No. 24, Hebbal, Bengaluru,
Karnataka–560 024, India
Phone : +(91)-(80)-23413125
Website : http://www.indiamart.com/company/1755856

8. **Go Green Farms**

Address : A-8, Improvement Trust Complex, Near HDFC Bank, Pathankot,
Punjab–145 001, India
Phone : +(91)-(186)-3290350, Cell Phone : +(91)-9888746006
Website : http://www.indiamart.com/company/2000755

9. **Sunglow Biotech**

Address : Krishna Raja Nagar Avenue, 12th cross, New Thillai Nagar
1st Avenue, Vadavalli Post
Phone : +(91)-(422)-431912, Cell Phone : +(91)-9842233485
Website : http://www.indiamart.com/company/88240

10. **Toyo Floriculture Co.**

Address : Toyo Sthan Gardens, Toyo Adoor House, Thevally Post, Kollam,
Kerala–691 014, India
Phone : +(91)-(474)-2707359/2793392
Cell Phone : +(91)-9447015054
Website : http://www.indiamart.com/company/1358775

11. **K.S.V. Exports**
    Address : 25, 6th St, Sowrastranagar, Choolaimedu, Chennai,
    Tamil Nadu–600 094, India
    Phone : +(91)-(44)-24844891
    Cell Phone : +(91)-9840168271
    Website : http://www.indiamart.com/ksvexports

12. **Hafi Tissue Culture World**
    Address : Ambunad, Pokkattupadi,, Aluva, Kerala, India
    Phone : +(91)-(484)-2686065/3222353
    Website : http://www.indiamart.com/company/2088068

13. **Phonecia Decor**
    Address : 23, Marquis Street, Kolkata, West Bengal–700 016, India
    Phone : +(91)-(33)-22446738
    Website : http://www.indiamart.com/company/1515049

14. **Singhal Enterprises**
    Engaged in exporting of all types of orchids.
    Address : S/2, Sunny Terrace, Ambadi Road, Vasai West, Thane,
    Maharashtra–401202, India
    Phone : +(91)-(250)-6452055 Fax : +(91)-(250)-2339513
    Cell Phone : +(91)-9881152108
    Website : http://www.indiamart.com/company/1950596

15. **Mistletoe**
    Wholesale seller and exporter of orchids.
    Address : 46-B, Raja Naba Krishna Street, Kolkata,
    West Bengal–700 004, India
    Cell Phone : +(91)-9830164023/9038742011
    Website : http://www.indiamart.com/company/2132358

16. **G.S.B.C. Globals**
    Exporter of all kinds of orchids.
    Address : 301, 3rd Floor, Lakdikapul, Hyderabad
    Andhra Pradesh–500 016, India
    Phone : +(91)-(40)-64540521
    Cell Phone : +(91)-9177646467

17. **Aarshasree Orchids**
    Address : Aarsha, Chennilode, Medical College PO, Trivandrum,
    Kerala–695 011, India
    Phone : +(91)-(471)-3054617
    Cell Phone : +(91)-9387813212/9388116245
    Website : http://www.indiamart.com/company/577789

18. **Natural Synergies Limited**
    Address : 8/3, Century Court, Kasturi Estate, Ii Street, Chennai
    Tamil Nadu–600 086, India
    Phone : +(91)-(44)-24997747
    Fax : +(91)-(44)-24997257

19. **Dhanus Agro & Chemicals**
    Address : Central Office 6-B, Mena Kampala Arcade
    113/114, Theyagaraya Road, T. Nagar, Chennai
    Tamil Nadu–600 090, India
    Phone : +(91)-(44)-28151135
    Fax : +(91)-(44)-52054445

20. **Gangully Trading**
    Address : 9/4, Thakurdus Dutta 1st By Lane, Howrah
    West Bengal–711 101, India
    Phone : +(91)-(33)-26434172
    Fax : +(91)-(33)-28297656
    Cell Phone : +(91)-9831243845
    Website : http://www.indiamart.com/company/924608

21. **Midas Plant Laboratories**
    Address : Perumal Koil Street, Tharapakkam, Chennai
    Tamil Nadu–602 101, India
    Phone : +(91)-(44)-23764229
    Fax : +(91)-(44)-23760913
    Cell Phone : +(91)-9841028487

22. **Spring Blossoms**
    Address : 38, Shivaji Park Keluskar Road, North, Mumbai
    Maharashtra–400 028, India
    Phone : +(91)-(22)-24449445/32496060
    Cell Phone : +(91)-9323296382
    Website : http://www.indiamart.com/company/948117

23. **ICL Flora Exotica**
    Guwahati

24. **Zopar Floritech**
    Address : 4075, 5th Cross, 19th main, HAL Iindstage
    Bangalore–560008, India
    Phone : +918041480196/197/198
    E-mail : zoparexpo@yahoo.co.in

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INSECT PESTS OF ORNAMENTAL FLOWER PLANTS AND THEIR MANAGEMENT

M. L. Chatterjee

Introduction

Ornamental plants i.e. different types of flowers are attacked by numerous insect pests. Due to attack by different pest the quality of flowers are deteriorate and sometimes cause severe yield loss. In recent scenario of flower cultivation for economical benefits in the domestic & export market the growers & entrepreneurs are facing tremendous problems for the pest attack & their management in flowers cultivation. Following are some of the lists of some flowers and their major insect-pests, and their management given.

1. Chrysanthemum :

It is one of the most popular flower of wide range in shape, size and colour. The flowers bloom from September to January. Commercially grown in many parts of India.

Some of the major pests of chrysanthemum flower are—

(a) Coleopteran Pests—different types of beetles, feed on flowers, leaves etc.

(b) Dipterian Pests—Leaf miner make zigazag silvery lines on the leaves.

(c) Hemipterian Pests—Aphids, suck sap from stem, leaves, flowers and flower buds. Due to infestation flower buds remain unopened flower remain small. The bugs also attack and buck sap from stem, leaves and flowers.

(d) Lepidopteron Pests—The leaves of hairy caterpillar feed on leaves and flower from October to January. Young Caterpillars destroy the leave by feeding on them gregariously. The larvae of Helicoverpa (boll worm) feed on petals and reproductive parts of flower that shows ugly appearance.

(e) Thysanspteron Pests—Thrips also attack on flowers and part of flower becomes brown.

Management :

All these pests are effectively controlled by the application (spray) of following chemicals at different times when require.

(i) Diclorvos–76EC (Nuvan, Vapona)—0.7 ml per litre water for control beetles, caterpillar.

(ii) Endosulfan–35 E.C. (Endocel)—1.5 ml/Liter water for control of beetles, and lepidopteron pests.

(iii) Metasystox–25 E.C. (Metasystix)—2ml/Litre water for control of aphids & thrips.

2. Carnation (Dianthus) :

Cultivated for its elegant flowers and essential oil. Attack by some insect pest of which larvae of Helicoverpar is important. The larvae feed on leaves, flower buds and flowers. The attacked buds fail to open. Spraying of thiodan 35EC @ 1.5 ml/L or dichlorros 75EC @ 0.7 ml/L is effective against this pest beside this other pests are blister beetle, aphid, grasshopper and thirps are also attack on carnation to some extent they are effectively checked by the application of the above chemicals from time to time.

3. Dahlia :

The flowers of various colour are produced from January to April. The plant is attacked by 13 species of insects of which bealles, leaf miner, leaf hopper, Helicoverpa (boll worm) cause extensive damages on flowers leaves and stem.

For effective control of these pests-mixed formulation of cypermethrion + chlorpyriphos 55EC (Nurelle-D, Hamla, Virat etc.) @ 1 ml/Liter. is effective.

4. Hollyhock :

It produces white, pick, or purple flowers from February to June. The insect tinged bug and spotted bollorm are most serious. Effectively controlled by sprying of thiodam or dichlorvos.

5. Marigold (Ganda) :

Its flowers are extensively used in religious and social functions. The plant attacked by different insects during various stages of growth, of which some maggote of Dipteran pest, tingid bug larvae of Helicoverpa and thrips are important. All the pests are successfully managed by the application of dursban @ 2 ml/Litre or throdan @ 1.5 ml/Litre water at timely intervals.

6. Balsam :

It is grown throughout India for its white, orange, Pink or Violet flowers which are produced from August to December. The plant is attcked by few Coleopteran bettes and Lepidoptran pest.

7. Chisra shoe Flower—(Hibisans sp) :

The shrub bears rose scarlet flower thorughout the year. Attacked by number of insects. Such as foleopteran beettes make holes on leaves & cut stem cause severe daserage of plants.

Aphid, collour bug, leaf hopper and mealy bug cause severe damage of the plant throughout the year.

Lepidopteran pest—Bihar hairy caterpillar and gram caterpillar also attack the flooder plant throughout the year.

For successful control fo these pest—application of carbaryl 50 W.P. @ 1 gm/Litre, or nuvan 76EC @ 0.7 ml/Litre or mixed formulation of chlorpyrifox + cypermethrine @ 1 ml/litre water (nurella—D. virat etc) or triazophos–40 ES @ 1.25 ml/litre are recommended.

8. Rose :

Roses are grawn throughout the world for culflowers and essential oils. Rose plant is attacked by numerous insect pests of which coleopteran bees and weevils attack on stem root and other parts of plant. Some bees feed on flower of rose. White fly sucks from leaves, Aphid is present on cutltivated varieties of roses from September to December. Termites feed on roots and rootlets of rose plant. The damage is most severe in Bandy com soils. The attacked plant withers and dies.

Larvae of Achae sp. feed on leaves. Due to infestation the whole plant is defoliated. The bark eating caterpillar feed on bark of rose plant.

Rose mite also cause serious damage to rose plant. The leaves become folding and curling due to combine attack of thrips mite pest.

Control :

(i) Apply dursbam (chlorpyrifos) @ 5 ml/L. with irrigation water for control of root pest like, termite, beetle and group of becllin.

(ii) Sprying of dicotol 2.5 ml/L for control of mite pests.

(iii) Spring of thiodan @ 1.5ml or nuvan 0.7ml + metasystox @ 2ml/L. dates for control of others pests at 15 days intervals. Uses of blitox 4 gm/L or bavistist 1 gm/L. and mixed with any insecticide will be very effective against combine attack of insect pests and diseases.

ORNAMENTAL PLANTS :

ROSE

(A) Termite (*Microtermes obesi*)

Occurrence and Symptoms : Termite attack starts under dry soil conditions. Small colonies are formed inside the soil and insect multiply very rapidly during rainy season. They destroy underground part including roots of young as well as old plants. Affected plants wilt, dry and die consequently.

Management : Drenching of rose bed with chlorpyriphos.

ICAR recommendations :

- Deep ploughing
- Timely irrigation
- Drenching soil with chlorpyriphos 0.05%.

(B) Red Scale (*Aonidiella aurantii*)

Occurrence and Symptoms : Scale appears in severe form before and after the monsoon. Adults and nymphs suck sap from mature shoots and deplete vigour of the plant. Reddish brown encrustation are formed on infested shoots.

Management : Spraying of the affected plants with methyl demeton, malathion, dimethoate.

ICAR/CIB recommendations :

- Selection of scale free planting material.
- Cutting and burning of infested parts.
- Spraying with dimethoate or ethion.
- Application of pongamia oil 10% to pruned shoots.

(C) Aphid (*Macrosiphum rosae*)

Occurrence and Symptoms : High humidity and cloudy weather (October-November) favours rapid build up of the pest. Both nymphs and adults suck cell sap and devitalize the plant. Affected leaves get deformed and the growth of the buds is retarded.

Management : Spraying of dimethoate, imidacloprid, acetamiprid.

ICAR recommendations :

- Spraying of oxydemeton methyl or dimetoate.
- Spraying of neem or pongamia oil 2%.

(D) Thrips (*Rhipiphorothrips cruentatus* and *Scirtothrips dorsalis*)

Occurrence and Symptoms : Thrips inhibits the under surface of tender leaves and suck sap from leaves and flower buds. Mottled and deformed young leaves with brown or silvery patches or burnt margins and deformed flowers are the main sign of attack.

Management : Spraying with dimethoate, abamectin, acetamiprid, imidacloprid, thiamethoxam.

ICAR recommendations :

- Spraying of acephate or profenophos or imidacloprid @ 0.05%.
- Spraying with combination of dimethoate or oxydemeton methyl with pongamia oil 0.5% for 2-3 times at 15 days interval with onset of new flash.

ORCHID

(A) Thrips (*Anaphorathrips orchidaceus*)

Occurrence and Symptoms : Both adults and nymphs suck sap from the foliage or growing flower buds causing silvery areas on the plants. Flower buds are deformed and even failed to open.

Management : Spraying with dimethoate, abamectin, acetamiprid, imidacloprid, thiamethoxam.

ICAR recommendations :

- Spraying of oxydemeton methyl or dimetoate or monocrotophos @ 0.05% at 10 days interval at early stage of infestation.

(B) Sacles (*Diaspis boisduvalli*)

Occurrence and Symptoms : Both adults and nymphs suck sap from the leaves petioles and shoots by injecting toxins into the plant. Affected plants lose vigour and become stunted in growth.

Management : Spraying with systemic insecticides.

ICAR recommendations :

- Selection of scale free planting material.
- Cutting and burning of infested parts.
- Spraying with dimethoate or methyl parathion.

GALDIOLUS

(A) Thrips (*Taeniothrips simplex*)

Occurrence and Symptoms : Thrips feed on the flower and floral sheaths. Both nymph and adults scrap the foliage and flowers cause silvery, white streaks. Thrips also thrive on corns in storage.

Management : Spraying with dimethoate, abamectin, acetamiprid, imidacloprid, thiamethoxam.

ICAR recommendations :

- Spray acephate 0.1% 2-3 times at 10days interval.
- Storing of infested corms at 2^{0}C for 6 weeks and treating them in hot water at 46^{0}C.

(B) Mealy bug (*Ferrisia virgata*)

Occurrence and Symptoms : Nymphs and adults damage corms by sucking the sap resulting in shriveling and drying of affected corms.

Management : Spraying with dimethoate, acetamiprid, imidacloprid, thiamethoxam.

ICAR recommendations :

- Spray acephate 0.1% or dimethoate 0.04% or methyl parathion 0.04% or pongamia oil 2% at fortnightly interval.

(C) Leaf caterpillar (*Spodoptera litura*)

Occurrence and Symptoms : Early instar larvae scrap on the lower surface of the leaf and sceletonize the same. Older larvae feed voraciously on leaves during night.

Management :

- Collection and destruction of egg masses and leaves infested with early larval instar.
- Deep ploughing during summer.
- Spraying of SlNPV, *Btkk*, emamectin benzoate, NSKE, or thiodicarb or chlorpyriphos.

ICAR recommendations :

- Spraying of quinalphos 0.05% or carbaryl 0.2% or neem seed kernel extract 4%.

CHRYSANTHEMUM

(A) Aphids (*Macrosiphoniella sanborni*)

Occurrence and Symptoms : Aphid sucks sap from growing stem tips and under surface of leaves causing loss of vigour. They also carry virus diseases.

Management : Any systemic insecticides like dimethoate, abamectin, milbemectin, can control the insect.

ICAR recommendations :

- Spraying of pongamia oil or neem oil 2%.
- Spraying of oxydemeton methyl or dimetoate.

(B) Thrips (*Microcephalothrips abdominalis*, *Frankiniella* spp.)

Occurrence and Symptoms : Thrips are slender white to black insect feed on growing point causing mottling and distortion of leaves. This insect also damage flowers of summer blooming cultivation. The effected flowers look as if dried due to scorching sun.

Management : Spraying with dimethoate, abamectin, acetamiprid, imidacloprid, thiamethoxam.

ICAR recommendations :

- Spray acephate or dimethoate at 0.05% 2-3 times at 15 days interval.
- Drench the soil with chlorpyriphos 0.1% to control pupae.

(C) Leaf miner (*Liriomyza trifolii*)

Occurrence and Symptoms : Leaf miners attack chrysanthemum both in green house and field. Incidence is severe in March-June. Larvae mine leaves by feeding on mesophyll. Severely infested leaves dry up.

Management : Removal and destruction of infested leaves. Application of thiamethoxam 70 WS, abamectin, clothianidin, monocrotophos.

ICAR recommendations :

- Use yellow sticky trap coated with chlorpyriphos 0.05% to reduce adult population.
- Collection and destruction of infested leaves.
- Spraying with triazophos 0.06% or profenophos followed by pongamia oil 1%.

TUBEROSE

(A) Weevils (*Myllocerus* spp.) :

Damage Symptoms : The adult weevil become active in darkness. Generally they feed at the edge of leaf producing a characteristic notched effect. The larvae feed on roots and tunnel into the bulbs.

Management : Spraying with *Beauveria bassiana*, NSKE, chlorpyriphos or alphamethrin or cypermethrin at recommended doses.

ICAR recommendations :

- Fortnightly sprays of malathion 0.1 % or carbaryl 0.2 % taken up during evening.

(B) Thrips

Damage Symptoms : Both adults and nymphs suck the cell sap from the leaves, buds and tender shoots. Damaged plants turn brown, get distorted and dry in case of severe attack. Damage to young plants results in stunted growth.

Management : Spraying with abamectin, dimethoate.

ICAR recommendations :

- Spraying of oxydemeton methyl or dimethoate or monocrotophos at 0.05 % at 10 days interval.

(C) Bud borer (*Helicoverpa armigera*)

Damage Symptoms : Larvae bore into buds and flowers and feed on them by making holes.

Management : *Btkk*, HaNPV, Indoxacarb, spinosad.

ICAR recommendations :

- Spraying of endosulfan 35 EC or methyl parathion 50 EC.

Literature Consulted :

1. Plant Protection schedule for the Important crop of West Bengal, published by the Directorate of Agriculture, Govt of W.B., in consultation with all the universities of West Bengal 1996 & 2010.

IMPORTANCE OF MICROPROPAGATION METHODS, IT'S PROSPECTS FOR FLOWER AND RELATED CROPS

Kunal Mukhapadhyay, Banasri Das and Ashim Chowdhury

Introduction :

Micro-propagation is the practice of rapidly multiplying of stock plant material to produce a large number of progeny plants, using modern plant tissue culture methods. Micro-propagation is used to multiply novel plants, such as those that have been genetically modified or breed through conventional plant breeding methods.

The term biotechnology was coined by Karl Ereky, a Hungarian engineer in 1919. Today, biotechnology is a multidisciplinary activity and involving chemists, biologists, engineers and many other specialists. Several branches of biotechnology are as follows

- Bioinformatics (*computational biology*)
- Blue biotechnology (applications of biotechnology to the marine and aquatic fauna)
- Green biotechnology (biotechnology applied to agricultural processes; example would be the selection and domestication of plants via micropropagation & transgenic plants), Red biotechnology (applied to medical processes)
- White biotechnology, (industrial biotechnology)

An important aspect of all the green biotechnology process is the culture of cells and tissues and organs in a defined artificial media.

The method of Micro-propagation goes through several stages— establishment, multiplication, pre transplantation and finally transfer from culture. In the final stage, the produced plantlets are removed from the medium and transferred to soil or more commonly to potting compost for continued growth by conventional methods. The major advantage of micro-propagation is the production of numbers of plants that are clones of each other.

Floriculture is a $10 billion component of the U.S. economy. It develops, produces and uses cut flowers, foliage, potted flowering and foliage plants and bedding plants. The 28 major floriculture producing states report a farm gate value of domestic products of $2.15 billion. The main flower auction places for world flower trade are Holland, Japan, Brazil, Canada, Taiwan, Italy, China and Netherland.

In our country also, to introduce a good orchard and floriculture production unit an assured good quality planting material in a large volume can only be confirmed through tissue culture nurseries. The competitive markets of cut flowers have come on reality due to the quality planting materials supplied through tissue culture. Commercial cultivation of orchid, anthurium, gerbera, lilium, banana, bamboo etc are mainly dependent on the tissue culture planting material. Floriculture industry is targeting an annual $ 2-billion in export of floricultural products by 2012 in our country. Presently West Bengal exports flowers of Rs. 74.0 lakh annually.

Tissue Culture Media :

The greatest progress towards the development of nutrient media for plant cell took place between 1960 and 1970. The basic nutritional requirement of the cultured plant cell is very similar to those utilized by plants in soil condition. Each and every type of culture has unique requirements of one or more nutritional component thus a wide variety of salt mixtures have been reported in tissue culture media.

Functions of the Tissue Culture Media :

- Provide water (usually distilled water is used)
- Provide mineral nutritional needs
- Provide growth regulators
- Provide vitamins
- Provide organic compounds
- Provide access to atmosphere for gas exchange
- Serve as a dumping ground for plant metabolites

Composition of Tissue Culture Media :

A nutrient media composed of salt composition, carbon source, vitamins, phytohormones, and other organic supplements—

Salt Composition : Good media of tissue culture consists of different salts in such a ratio and concentration that it most nearly match the optimum requirements for cells or tissue growth. Mineral elements are essential for the life of a plant. A variety of salts supply the 17 essential macro and micro nutrients that are the same as those required by the normal plant, are the essential component of a nutrient media.

Carbon and Energy Source : The standard carbon and energy source of a nutrient media is sucrose or glucose. Fructose can also be used but is less efficient. The sucrose in the media utilized first followed by fructose. sucrose is used at a concentration of 2 to 5%.

Vitamins : Normal plant synthesizes the vitamins required for growth and development. A plant cell in culture also requires vitamins but is taken in from the medium. There is a absolute requirement of vitamin B1 (thiamine). Growth is also improved by the addition of nicotinic acid and vitamin B6 (pyridoxin), pantothenic acid, biotin, folic acid, riboflavine, and ascorbic acids are also used in different media.

Phytohormones : The two main classes of growth regulators that are of special importance in plant tissue culture are auxins and cytokinins, while the others viz. gibberellins, abscisic acid etc are of minor importance.

Auxins cause cell division, cell elongation and swelling of tissues and formation of adventitious roots. The compound most frequently used are 2.4 dichloro phenoxy acetic acid (2, 4-D), α napthalene acetic acid (α NAA), indole butyric acid (IBA), 2,4,5 trichlorophenoxyacetic acid (2,4,5-T), p-chloro phenoxy acetic acid (pCPA) and picloram. cytokinins play important role in shoot induction. The cytokinin compounds that are most frequently used are kinetin, 6 benzyle amino purine (BAP), zeatin and isopentenyl adenine. Gibberellins induce elongation of internodes and the growth of meristems or buds *in vitro.*

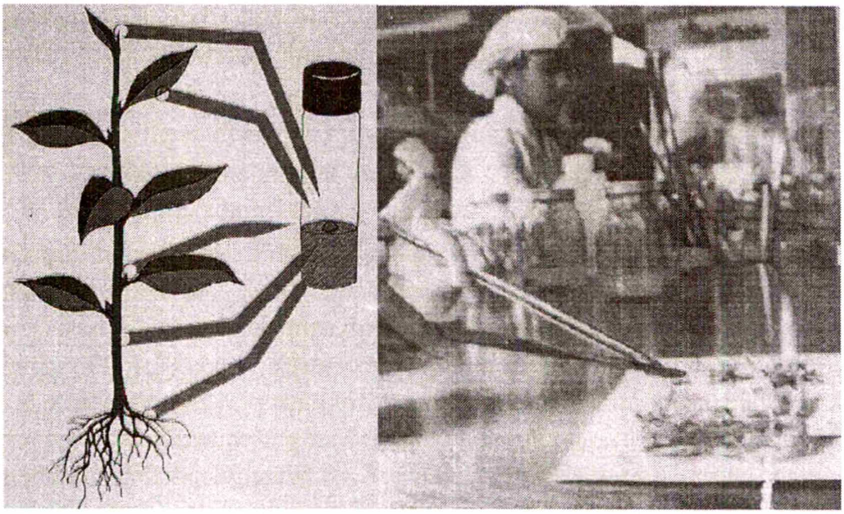
Organic Suppliments : Substances like different amino acids, organic acids, yeast extract, casein hydrolysate, malt extracts, coconut milk etc are used in various medium as a source of organic nitrogen. Agar, a sea weed derivative is the most popular solidifying agent used in tissue culture medium. Agar at a concentration of 0.6 to 1.0% (w/v) are used in tissue culture media. Alginate, gelrite, etc are other alternatives of agar.

Composition of proliferation medium for banana tissue culture is given below as an example : MS basal salts (Murashige and Skoog, 1962) containing thiamine (0.4 mg/L), myo-inositol (100 mg/L), sugar 30 g/L, is used as proliferation medium. Growth regulators like BAP 4 mg/L, IAA 1.6 mg/L and adenine sulfate 80 mg/L) is added to the medium. The pH is adjusted to 5.8 before autoclaving and agar (5 g/L) is used as solidifying agent, axenic shoots are separated out from the old explants and excised longitudinally. Excised plant tissue were used as explants. The explants are transferred to culture vessel contains the growth medium and maintained under 16h photoperiod with a light intensity of 10μ, mol m^{-2} s^{-2} (cool white fluorescent light) and a temperature at 25°C ± 2°C. After four or five weeks, 5 to 7 buds can be induced from each explant.

Explant Selection :

The plant organ tissue used for *in vitro* culture is called as explant. Explants of various organs vary in their rates of growth and regeneration, while some do not grow at all. The choice of explants material also determines if the plantlets developed via tissue culture are haploid or diploid. Also the risk of microbial contamination is increased with inappropriate explants. Thus it is very important that an appropriate choice of explant be made prior to start tissue culture.

EXPLANT SELECTION

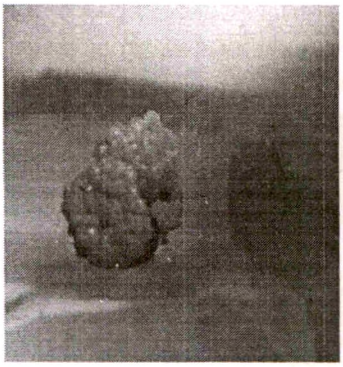


The significant factors in explants include differences in the stage of the cells in the cell cycle, the availability, or ability to transport endogenous growth regulators, and the metabolic capabilities of the cells. The most commonly used tissue explants are the meristamatic ends of the plants like the stem tip, auxiliary bud tip and root tip. These tissues have high rates of cell division and either concentrate or produce required growth regulating substances including auxins and cytokinins.

Stages of Micropropagation :

Stage I :

Micropropagation begins with the selection of plant material to be propagated. Clean stock plant materials (nodal/leaf/inflorescence/any tender meristamatic part); free from viruses, bacteria and fungi are important for the establishment of axenic culture. The prepared explant is then surface sterilized. Loss of explants due to contamination is a major problem at this stage. A two-step or multiple step procedure of surface sterilization is necessary to obtain a good number of aseptic stage I cultures. Another limitation at this stage is the exudation of phenol from explants and subsequent death of explants. Positive effects of antioxidants like ascorbic acid in reducing phenolic exudation and subsequent browning of explants is well documented in several cases. Addition of charcoal in the growth medium also improves the condition. Ddepending upon the media composition.the contamination free explant cell then starts to grow and subsequently differentiates either into shoot buds or causes elongation of axillary buds. Wide variation in response for the induction of shoot multiplication has been reported among different genotypes and also to the types of explants (root, stem etc.) of a single plant.

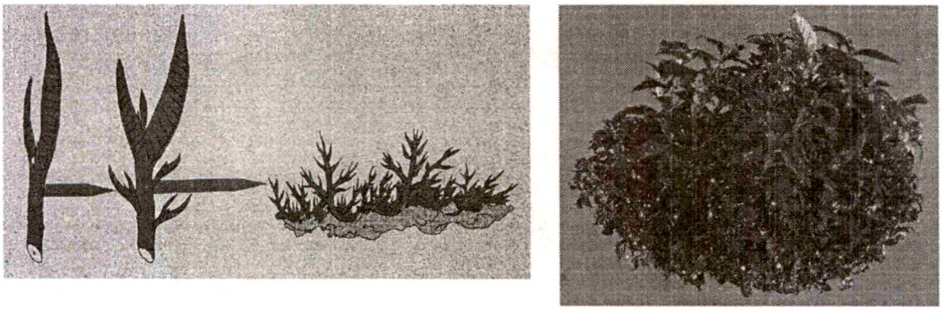


Callus

Organogenesis from Callus

Stage II :

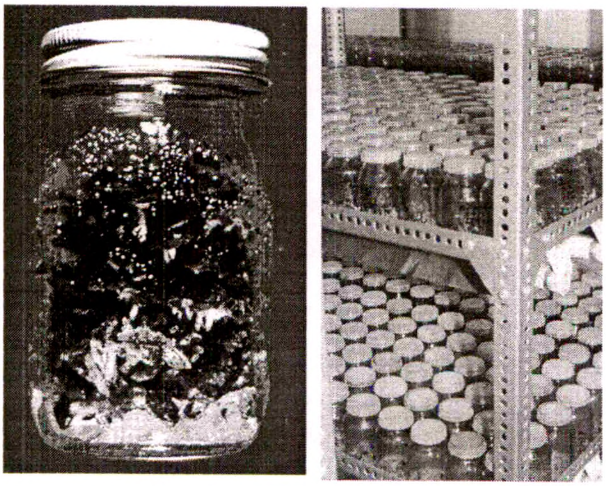
Multiplication is the taking of tissue samples, produced in the stage I for increasing the number. The process can be achieved either through the formation of multiple shoot or elongation of axillary buds up to 5 to 6 nodes. Elongated shoots/propagules (as produced through multiple shoot formation) from primary cultures were cut into pieces (for nodal culture; single node with internodes/for multiple shoots; 2-3 shoots per cluster) and transferred them to subculture medium for further proliferation. Thousands of plants can be obtained from single explants by repeating this process. Cares should be taken to avoid callus growth at the stage of multiplication, which may lead to the "Somaclonal variation". Somaclonal variation leads to genetical variation among the produced plant. A minimum 1 : 4 to 1 : 6 multiplication ratios after 4 weeks of culture time is desired for the commercial viability of a protocol. Delaying of sub-culturing period resulted in gradual browning of the shoots followed by total blackening. Hence sub culturing interval days is the most crucial factor to obtain desired level of healthy shoots.



Shoot Proliferation (Multiple Shoot Formation)

Stage III :

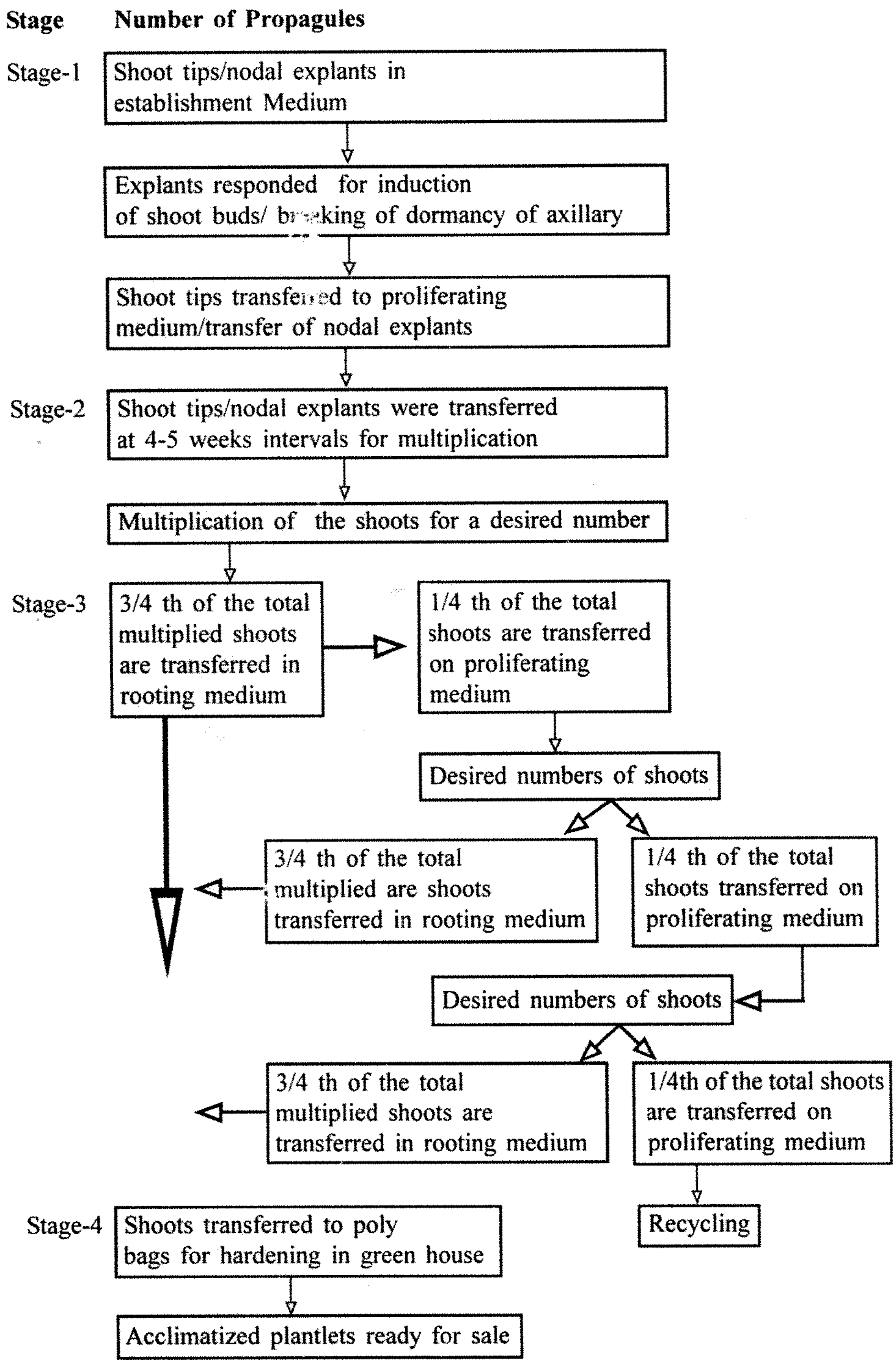
This stage involves treating the plantlets/shoots produced to encourage root growth. It is performed either *in vitro*, or *in vivo* condition.



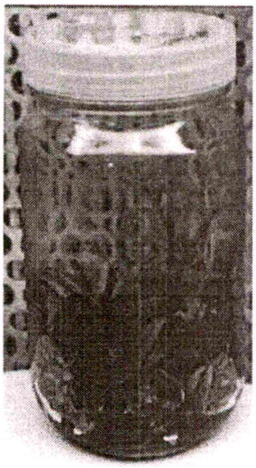
Stage IV :

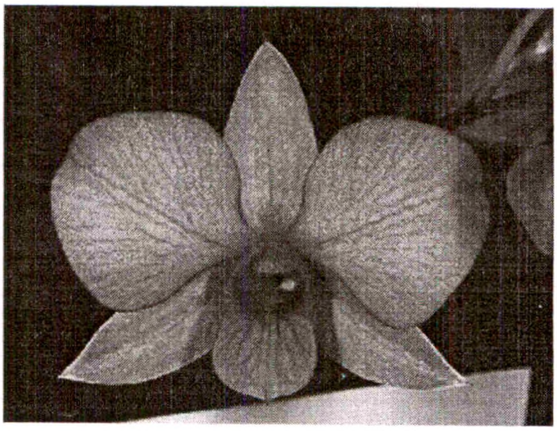
In the final stage of plant micro propagation, the plantlets are removed from the medium and transferred to soil or (more commonly) potting compost for continued growth *i.e.* "Hardening". Hardening refers to the acclimatization of the plants to the natural growth environment. Until this stage, the plantlets have been grown in "ideal" conditions, designed to encourage rapid growth. Due to lack of necessity, the plants often do not have fully functional dermal coverings and will be inefficient in their use of water and energy. *In vitro* conditions are high in humidity and plants grown under this condition do not form a working cuticle and stomata that keep the plant from drying out, when taken out from culture. The plantlets need time to adjust to more natural environmental conditions. Hardening typically involves slowly weaning the plantlets from an *in vitro* condition to a natural growth environment.

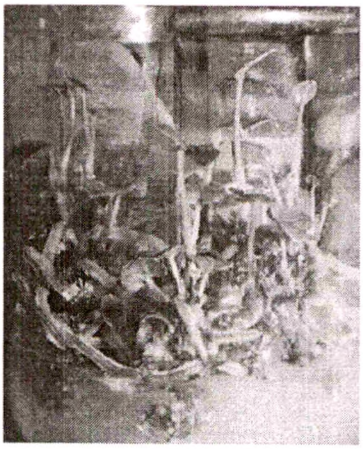
Flow Chart for Micro Propagation :

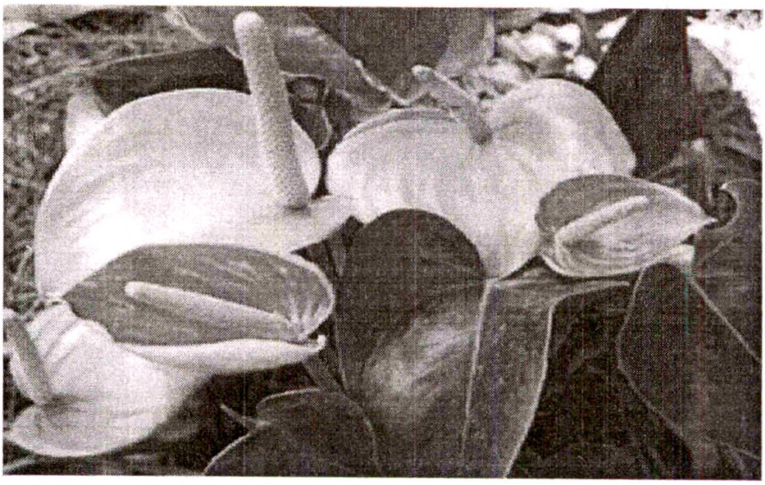

Stage
Number of Propagules
Stage-1
Shoot tips/nodal explants in establishment Medium
Explants responded for induction of shoot buds/ breaking of dormancy of axillary
Shoot tips transferred to proliferating medium/transfer of nodal explants
Stage-2
Shoot tips/nodal explants were transferred at 4-5 weeks intervals for multiplication
Multiplication of the shoots for a desired number
Stage-3
3/4 th of the total multiplied shoots are transferred in rooting medium
1/4 th of the total shoots are transferred on proliferating medium
Desired numbers of shoots
3/4 th of the total multiplied are shoots transferred in rooting medium
1/4 th of the total shoots transferred on proliferating medium
Desired numbers of shoots
3/4 th of the total multiplied shoots are transferred in rooting medium
1/4th of the total shoots are transferred on proliferating medium
Recycling
Stage-4
Shoots transferred to poly bags for hardening in green house
Acclimatized plantlets ready for sale

Micropropagation of Commercially Cultivated Orchid









Importance of Micropropagation methods, it's prospects for Flower

Advantages :

Micropropagation has a number of advantages over traditional plant propagation techniques :

Advantages

- The main advantage of micropropagation is the production of many plants that are clones of each other.
- Micropropagation can be used to produce disease-free plants.
- Micropropagation produces rooted plantlets ready for growth, saving time for the grower when seeds or cuttings are slow to establish or grow.
- It can have an extraordinarily high fecundity rate, producing thousands of propagules while conventional techniques might only produce a fraction of this a number.
- It is the only viable method of regenerating genetically modified cells or cells after protoplast fusion.
- It is useful in multiplying plants which produce seeds in uneconomical amounts.
- Micropropagation often produces more robust plants, leading to accelerated growth compared to similar plants produced by conventional methods-like seeds or cuttings.
- Some plants with very small seeds, including most orchids, are most reliably grown from seed in sterile culture.
- A greater number of plants can be produced per square meter and the propagules can be stored longer and in a smaller area.
- Continuous propagation year round.

Micropropagation Applications :

- Rapid build up of stock of new, superior variety
- Elimination of endophytic disease
- Better suited to morphology/growth characteristics (few offshoots/sprouts; date palms, ferns, nandinas)
- Propagules have enhanced growth features (multibranched character; Ficus, Syngonium)

Limitations :

Micropropagation is not always the perfect means of multiplying plants, conditions that limits its use include:

- It is very expensive and need skilled person.
- A monoculture is produced after micro propagation, leading to a lack of

overall disease resilience, as all progeny plants may be vulnerable to the same infections.

- An infected plant sample can produce infected progeny
- Sometimes plants produced through micropropagation are not true to mother type for somaclonal variation at culture level.
- Some plants are very difficult to disinfest of fungal organisms.
- Protocols not optimized for all plant species.

Mechanization of the process could reduce labour costs, but has proven difficult to achieve, despite of active attempts to develop technological solutions.Tissue culture has, in recent years, been recognized as an important tool in agriculture development. India is well placed to exploit the benefit of tissue culture based applications to floriculture crops. Tissue culture plants of ornamentals have found ready acceptance by the commercial growers. At present 30 commercial tissue culture units with annual capacities of 0.5 to 15 million plants each are in operation, resulting in total capacity of about 110 million plants. While most of it is exported, a small percentage of cut flower crops like carnation and gerbera are finding good market within the country.

As with any other technology, the success of tissue culture within the nursery industry will be determined only by economic factors. Whether the plantlets be produced in sufficient numbers as a cost to compare with traditional propagation? Will the propagules fit into the established production sequence of the existing nursery business? Are the propagules true-to-type? These answers must be obtained on a species by species, cultivar by cultivar basis.

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PRECISION FARMING ON HORTICULTURAL CROPS

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Introduction :

Precision farming is a new approach of crop management strategy to employ all inputs to be used in optimum level on the basis of site specific information. The precision technology is updating and upgrading by continuous efforts of scientists and farmers in combined form, which reflects more and more on horticultural crop cultivation in India in terms of quantity and quality. The farming community is getting the essence of benefit towards the management of all sorts of inputs used for crops husbandry. It has been estimated that 28 million hectors of land is unutilized in India and it can be brought under horticultural crop cultivation through precision farming. India is the second largest producer of fruits & vegetables and prime producer as well as exporter of spices, where only 18.6 million of hector (out of 143 million hector) of land is engaged for horticulture production and produces near about 210 million tones, which is equal to food grain production. There is greater scope of high quality production with the use of beneficial effect of precision farming. There are so many established and available technologies in finger tips in relation to highly productive, cost-effective, socially acceptable, ecologically viable and sustainable, but there is inadequate scope for extension of the same.

Objectives :

i. Utilization of local resource management through OFT.
ii. Empowerment of the extension functionaries, practicing farmers, farmwomen, rural youths and SHGs.
iii. Exploitation of germplasm potential.
iv. Introduction of Hi-tech horticulture.
v. More emphasis on post-harvest management through value-addition.
vi. Promotion of market led horticulture.

Aims :

i. To bring more area under horticultural crops.
ii. To prevent pollution of air and water for benefit of the human being.
iii. To improve soil health.
iv. To protect beneficial insects, worms, microorganism and fish.
v. To increase productivity and profitability in horticultural crop cultivation.

vi. To create more employment avenues and prevent migration of labors.
vii. To assure the availability of horticultural crops in the market throughout the year.

Precision Farming Technology :

i. Zero-tillage.
ii. Drip and sprinkler irrigation.
iii. Protected cultivation.
iv. High density planting.
v. Integrated nutrient management through bio-fertilizers.
vi. Integrated pest management through bio-pesticides.
vii. Mulching.
viii. Use of growth regulators, micro-nutrients and herbicides for quality production.
ix. Post harvest management.

Impact on Horticulture :

i. Zero-tillage technology is gladly accepted by the farmers in rain fed area for cultivation of potato, pea and leafy vegetable.
ii. Produces quality planting material in terms of seed, seedlings, and vegetative propagated plants through phyto-sanitary techniques by the nurseries.
iii. Water and fertilizers management through drip and sprinkler irrigation in all high value horticultural crops.
iv. Soil, water and weed management through mulching for plant survivability, seed germination, weed control and production of all horticultural crops.
v. Progressive farmers are aware regarding the vegetable cultivation under green house.
vi. Farmers are taking interest on use of bio-fertilizers and bio-pesticides instead of traditional practices.
vii. For quality assurance, farmers are using growth regulators and micro-nutrients on horticultural crops like GA_3 for growth and flowering, ethrel and ethephon for ripening and plant growth, NAA for fruit setting, IAA and IBA for rooting in nursery management. Similarly different micronutrients are used against deficiency symptoms of various horticultural crops.
viii. Now SHGs are producing Value-added horticultural products like Jam, jelly, sauce, ketchup, syrup, squash, pickles, morabba and chips etc. through processing.

There are several precision farming technologies established in Indian farming system are mentioned here under.

A. Gerbera Cultivation under Green House :

Gerbera is one of the most important cut flower grown in India and abroad, now its position in relation to commercial aspect is sixth out of the ten exporting cut flowers in world trade market at Holland. Gerbera producing states in India leading by Karnataka, Maharastra and Tamilnadu, West Bengal state have a greater scope for good quality of gerbera production for domestic market as well as export. Here, some farmers are producing gerbera in this state and that is not sufficient to full fill the demand in the local market, still this state is importing gerbera from other states. The details of cultivation practices are mentioned below.

Climate : 80-90% gerbera flowers are producing under green house, it can be grown well in West Bengal situation under low cost natural ventilated green house, where plants can get 50% shade during summer and 30% shade rest of the year with 8-10 hours sunlight. The optimum day and night temperature in favorable for gerbera growing is 20-25°C and 12-15°C respectively, but it can be grow well up to 30 and 20 degree centigrade temperature during day and night. Regarding relative humidity in the green house 80-85% is suited for vegetative growth and 70-75% is encouraging for flowers production.

Soil : Sandy loam soil with 6.5-7P^H is best for the cultivation of gerbera, the soil is enriched thoroughly incorporating with organic manures (cocopeat @ 100g + bone meal @ 100g + neem cake @ 100g + horn meal @ 100g/sq.m) followed by soil sterilization (drenching of chemical agent like formaldehyde (formalin : water = 1: 10) @ 7.5 lit./sq.m area). The beds are prepared in such a way that width and height should be one meter and 30 cm respectively. Among the beds should have a space (60 cm) for operational works and the length of the beds as convenient of the available space.

Planting : One month old of tissue culture plants were planted after 15 days of soil sterilization with spacing of 30×15cm, where 15-18 number of plants can be accommodate per square meter area. The best time for planting of gerbera is either before rains come or after rainy season.

Irrigation : Gerbera performs better under drip irrigation system (above the beds HDPV pipes of 10-16 mm diameter are to be spread in the rows among the plant), the quality of water is also very important in terms of P^H (6-6.5) and salt content (1.5-2.5%). For better growth and development of gerbera, water to be given twice in a week in winter and thrice a week in summer and winter season, whereas in rainy season generally watering once in a week is adequate.

Fertilizer Application : During vegetative growth 600gmN + 400P + 600gK + $CaSO_4$ (200gm) and $MgSO_4$ (200gm) 100 sq.m area/month fertilizers are used, whereas 600gmN + 400P + 800gK + $CaSO_4$ (200gm) and $MgSO_4$ (200gm)/ 100sq.m area/month along with $CuSO_4$ (0.2%) and $ZnSO_4$ (0.1%) at an interval of one month encouraging the flower yield per plant.

Harvesting : Gerbera flowers are starting to harvest after 3 month of planting and yielded 30-35flowers/plant/year that is 450-500 flowers/sq.m approximately. The effectively yield can be harvested up to three years and it is better up rooted the plants followed by new plantation. The stage of flower harvest is very important to marketing, it is evident that flowers to be cut when outer two florets are perpendicular to the stalk and cut end to be dipped in the water.

Plant Protection : Soil sterilization to solve the maximum problem of diseases, some times root rot and foot rot have been occurred and it is control by drenching copper oxychloride (0.4%), sometimes it happens that leaf blight is a very serious problem in high humid condition by both the infection of fungus and bacteria and it is better as a preventive measures by alternate spraying of bavistin (0.1%) and streptomycin (0.01%) at an interval of one month. Mite is a serious problem during high temperature in green house and it can be controlled by spraying of kelthane (0.1%), thiodan (0.2%), and tendion (0.2%) at 15 days interval reported by P. Das and P.K. Singh Samanta (1999).

Commercial Variety : The best identical varieties for cultivation of gerbera under green house in West Bengal situation are Dusty (red), Flemingo (pale rose), Fredaisy (pink), Fredeking (yellow), Fredorella (red), Maron Clementine (orange), Nadja (yellow), Terraqueen (pink), Uranus (yellow), Valentine (pink), Vesta (red) and Delphi (white).

Cost of cultivation : By spending of Rs. 50,000.00 for the 100 sq.m area for a low cost green house, farmers can earn up to Rs. 30,000.00 per year by gerbera cultication.

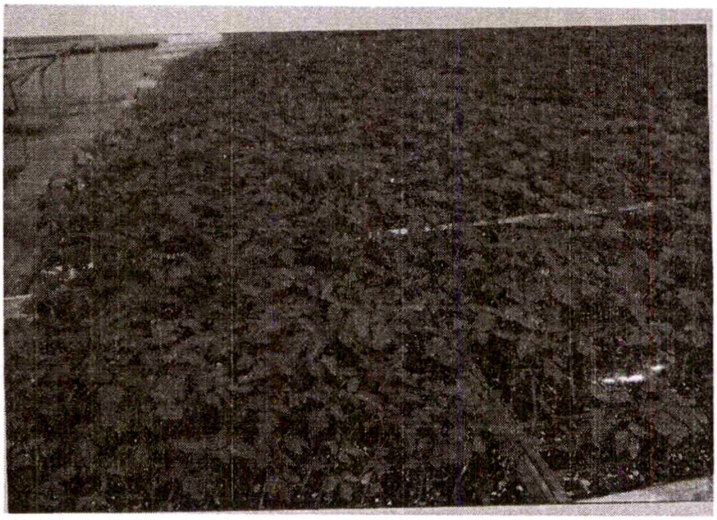
A. Healthy Vegetable Seedling Production under low cost Shade House :

This is the very simple structure like a hut and this structure is stand with bamboo/wood/G.I. pipe/M. S. structure/stone pillar/cement concrete pillar. The roof frame is constructed with bamboo/G.I. pipe/M.S. structure and roof is covered by use of DHPE or LDPE (25-75% agro-shade net). The sides of this house are throughout covered with use of 40/50-mesh insect proof nylon net. The beneficial effect of this shade house is to cut off the sunlight, increased humidity, reduced temperature and protect the insect. This is much-popularized as good as green house effectively used in nursery management through out in India. The bamboo and wooden made structure durability is only 4-5 years, but it is very low cost structure, whereas other materials made structure is stand long run and cost of installation is too much. This structure is very effectively used in summer and winter season for quality vegetable seedlings production like cauliflower, cabbage, Capsicum, tomato, bringal and cucumber to keep the moisture in the seed bed for better germination. The details of seedlings production techniques are mentioned below.

Beds for Raising of Seedlings under Shade House :

The selected place for beds is to dug up to 20 cm depth and removed all the foreign particles. Dry the soil in sun light at least three days and then mixed with FYM/Well rotten cow dung manure @ 10 kg + vermicompost @ 1 Kg + 50 gm SSP + 25gm MOP/sqm area. After mixing all the ingredients, it should be sterilized by use of hot water followed by polyethylene mulching manually and another cost effective sterilized method is drenching of chemical agent like formaldehyde (formalin: water = 1 : 10) @ 7.5 lit./sqm area, but there is a limitation that no seed will sown up to two weeks after treatment. Generally the size of the bed will be in terms of length, width and height are 10, 3, 0.5 ft respectively, whereas among the beds should have 2 feet space for intercultural operations and lifting of seedlings from nursery beds. There is no limitation of length of beds and it is depends on convenient space is available, but the bed area should be 2% slanting slope. Above the beds HDPV pipes (10-16 mm diameter) are to be spread at once in 2 meter intervals. Nearly 300-350 sq.mt area is required for raising of one hector seedlings.

Portrays seed beds for raising of vegetable seedlings : These seedbeds are extensively used in precision farming for raising of high value vegetables under green house, net and shade house. Here, tray is made by the use of polypropylene (0.8mm thickness), where uniform size of 98 pockets is made and each pocket has one hole in the bottom for drainage of water. The size of the pockets should be different in different vegetable crops like tomato (3.5cm), cabbage (3.5cm), redcabbage (3.5cm), cauliflower (3.5cm), broccoli (3.5cm),



capsicum (3.5cm), brinjal (3.5cm), cucumber (7.5cm), muskmelon (7.5cm), watermelon (7.5cm). Generally the portray size is available in the market is 54 × 27 sq.cm, where for one hector cultivation for different vegetables crops need various number of trays (240 number of trays required for tomato and capsicum, 200 trays for brinjal, 600 trays for cabbage, cauliflower, red cabbage and broccoli). The sterilized coco peat is used for growing media (300kg/ha for tomato, brinjal, capsicum and 700 kg for cabbage, cauliflower, red cabbage, broccoli and 1.25 kg required for filling each tray) for the raising of seedlings and growing media is further enriched with neem cake (5 kg/ha for tomato, brinjal, capsicum and 10 kg for cabbage, cauliflower, red cabbage and broccoli) + *Azospirillum* (1kg/ha for tomato, brinjal, capsicum and 2 kg for cabbage, cauliflower, red cabbage and broccoli) + Phosphobacteria (1kg/ha for tomato, brinjal, capsicum and 2 kg for cabbage, cauliflower, red cabbage and broccoli). Before sowing of seed, the seed should be treated with hot water (50°C) for half an hour followed by seeds are mixed with *Azospirillum* @ 100g/kg of seed and dried in shade for half an hour. After seed treatment, one seed to be sown in each pocket and covered with cocopeat followed by mulching with polythene (5-6days) till seed germination. The trays are watering twice in a day morning and evening with seedling can. When seedling age reached 15 days, the trays are drenched with 10-26-26 fertilizers (4gm/lit of water) for feedling for better growth and development, finally the seedlings are ready within 21-25 days after sowing for transplanting.

Cost of Production : Generally the vegetable seedling production cost per plant is Rs.0.20-25, whereas its market price at present Rs.0.40-0.50/seedling and throughout the year vegetable seedling production can be taken under shade house.

B. Production of Grafted Cashew Nut and Mango plants in Poly-Pack under Shade House

Environment for plant propagation : Shade house is suitable place for propagation like cutting, budding and grafting. It has been found that percentage of success under shade house condition for cutting, budding, grafting has found 90-100%, 85-95% and 80-90% success respectively in different horticultural crops. Not only that, plants are multiplied in the shade house and its percentage of survivability in pots are more as compare to produced in open condition. This type of infrastructure may be use throughout the year for round the year production of mango and cashew nut grafted plants in the nursery. The details of propagation techniques are mentioned below.

Production technology of cashew nut grafted plants: Cashew nut is the rich men food under poor men cultivation, grow in poor soil. Now Paschim Medinipur district of West Bengal is identified by NHM for cashew growing belt. Previously, here cashew seedlings are planted by the forest department in the forest area. Recently, farmers are taking interest on grafted cashew nut Var. V-4, V-7 and BPP-8 are planted on their waste land, but still these plants are brought from Orissa state. However, here is a greater scope of quality plant production and marketing with high profit margin. Rural youths can take this opportunity by developing a model nursery in this state for grafted cashew nut plant production for supplying to the horticulture department. It has been estimated that near about one lakh hectors of land is going to be planted by cashew near future in this state and three corers of plants to be required to cover aforsaid area.

Raising of rootstock : Collect of seed cashew nut var. Midnapore Yellow, H-3-13, Lal-Hazari, BN-40, NLR-2-1 in the month of May and drying for 2-3 days. Before sowing of seed, the growing media should be ready with mixing of one part soil + one part cow dung manure or leaf mould + 1.5 part sand and again the growing media is enriched with 5gm 10-26-26 + 5g neem cake/ plant. The growing media is filled in 300 gauge black poly pack (the size of poly pack should be 25cm length and 15cm width) having six holes on the lower side of the poly-pack. When growing media is ready for sowing of seed, seeds are dipped in the water for 12 hours and one seed for each poly pack place up to 2.5cm depth in the growing media followed by mulching with straw and watering. Every day watering should be given in the evening and after 15-20 days, when new shoots come up to remove straw followed by spraying of borodex mixture (1%) and continue fifteen days intervals up to two months. For better growth and development of rootstock, the plants were treated with by spraying phytanol MI @ 1gm/5 lit. of water at 15 days interval.

Selection and forcing of scion: For the red and lateritic areas the best suitable potential yield varieties in terms of quantity and quality are V-4, V-7 and BPP-8. When root stock become two months aged, the branches of selected varieties to be treated for forcing in the month of August for development of scion. During forcing, the selection of branches is very importance; it should be more the 3 months age and pencil thickness diameter. The selected branches of leaves to be removed up to 15cm from the terminal bud, but petiole should be in tacked, after 7 days when petiole to start leave from the branches, it is indicated that branches are ready for grafting, that is scion.

Wedge grafting: July to September is ideal for wedge grafting in a year. The rootstock plants are bringing under shade from nursery beds and beheaded with secateurs above 45cm from the ground level having 3-4 nodes with leaves. The middle of the cut end of the root stock should split up to 5cm depth by grafting knife. Then prepare scion to be separate from mother plant of 15cm length. The cut end of scion should make V-shaped by slanting cut in both side up to 5cm and inserted in the root stock and tied with polythene (200 gauge 5cm width). The scion to be covered with poly tube up to graft union and during this time every day watering should be given to induce early sprouting. After 4-5 days the tube should be removed, when tip portion of the scion sprouted in the form of new leaves. Just after grafting, grafted plants to keep for 7 days in the shade house and then placed under 75% shade for 15 days followed by 50% shade for a month for hardening. There is every possible to sprout of buds below the graft union and it should be pruned as early as possible, similarly after passing of winter season plant produce profuse flower and it should be thin out immediately. The grafted plants are regular spraying with phytanol MI @ 1gm/5 lit. of water at one month interval and similarly copper oxychloride 2g/lit of water drenching in the soil at an interval of one month.

Cost of production : It has been estimated that Rs. 10.00-12.00 will be the production cost of cashew nut of latest varieties, market price of these plants are Rs. 20-22. There is a huge demand from government side for plantation in waste land, but still this state is procuring from other states. Availability of scion is the main problem, but it can be procured from orchard, which has established in the farmers field during last few years in the district of Paschim Medinipur.

Production technology of Mango grafted plants : Mango is the National fruits of India, where most of the species originated in this country and India is sharing near about 50% of the total world production, not only that India is the highest exporter of mango. The district of Paschim Medinipur, Bankura, Purulia and Birbhum of West Bengal has a greater scope of mango cultivation in the red and lateriotic belt. Presently under area expansion of mango of NHM for waste land management for these district have been started during last 5 years, but plant survivability is very poor due to inferior quality of plant production in the nursery. So, there is a greater scope of plant production in polythene through veneer grafting for supplying to the farming community with high margin profit. Rural youths and SHGs can take this opportunity and developed a model nursery in this aspect.

Rising of rootstock : Collect of mango stones and sown in the nursery beds for rising of seedlings, when seedling age reached two months old it should be transplanted in the poly pack. Before transplanting of seedlings, the growing media should be ready with mixing of one part soil + one part cow dung manure or leaf mould and again the growing media is enriched with 6gm 10-26-26 + 10g neem cake/plant. The growing media is filled in 300 gauge black poly pack (the size of poly pack should be 25cm length and 15cm width) having six holes on the lower side of the poly-pack. For better growth and development of rootstock, the plants were treated with spraying of phytanol MI @ 1gm/5 lit. of water at 15 days interval.

Selection and forcing of scion : For the red and lateritic areas the best suitable potential yield varieties in terms of quantity and quality as well as commercial point of view are Bombai, Golap Khas, Amrapali, Mallika and Chausa. One year old seedlings are used for rootstocks for grafting and when it is ready the selected terminal branches are to be forced for scion development. During forcing, the branches age should be not less than 3 months and not more than 6 months with pencil thickness diameter. The selected branches are defoliated up to 15cm from the top, but petiole should be in tacked, after 7 days when petiole to start leave from the branches, it is indicated that branches are ready for grafting, that is scion.

Veneer grafting : March to September is ideal for veneer grafting of mango in a year. Under 50% shade house, the rootstock plants are bringing from the nursery beds and a slanting cut(5cm long), an oblique cut is then made so that a piece of wood along with bark is removed. The base of the scion wood is then fitted into the rootstock in such a manner that the cut surfaces, including the cambium layers of scion and rootstock are facing each other. The rootstock and scion are tied each other with polythene (200 gauge 5cm width). The scion to be covered with poly tube up to graft union and during this time every day watering should be given to induce early sprouting. After 4-5 days the tube should be removed, when tip portion of the scion sprouted in the form of new leaves. There is every possible to sprouted of buds below the graft union and it should be pruned as early as possible, similarly after passing of winter season plant produce profuse flower and it should be thin out immediately. The grafted plants are regular spraying with phytanol MI @ 1gm/5 lit. of water at one month interval and similarly copper oxychloride 2g/lit of water drenching in the soil at an interval of one month.

Cost of production : It has been estimated that Rs. 8.00–10.00 per plant will be the production cost of grafted mango plants on aforesaid varieties including all expenses, where market price of the grafted plants established in poly pack Rs. 15–17/plant. There is a huge demand from government side for plantation in waste land management in up-medium land situation, but still these plants are producing inferior quality, resulted less survivability in the farmers' field. Availability of scion is the main problem, but it can be procured from orchard, which has established in the farmers field during last few years in the district of Paschim Medinipur.

C. Pomegranate Cultivation with Drip Irrigation in Red and Lateritic Belt :

India is the second largest producer (34,811 tones) of pomegranate after Iran (67,000 tones), but due to poor quality only sharing 3% of export in the world trade market. There is a bright future for export quality pomegranate fruit production in India. Climate and soil is the main factor for quality fruits production rather than agro-techniques, in this context red and lateritic belt and its environment of West Bengal is an ideal for pomegranate cultivation. The details of modern cultivation practices is mentioned below.

Soil : Sandy to sandy-loam soil up to 60cm depth is suitable for pomegranate cultivation and before going to cultivation, to bring the soil in neutral position with application of lime 4 tones per acre and continued every alternate 3 years.

Commercial Varieties : Mridula, Jyoti, Bassein Seedless and Ruby are the best varieties for this belt.

Planting : Spacing to be maintain 3×5 meter (plant to plant and row to row), where sized of the pit should be 0.6×0.6×0.6 meter. There should be a trench having one meter depth among the rows to avoiding wilt of plant, the suitable time for pit preparation in the field is in the month of May. The pits are treated with sun light for a month and filled with 10 kg well rottened cow dung manure + 200gm bone meal + 200gm neem cake + 100gm SSP in the month of June. The air-layered with good quality of one year aged plants having 2-3 branches are planted when rain start. After planting, plants are treated by drenching with chloropyriphos 2ml/lit of water at one month interval to avoid termite attacked, whereas for proper growth and development, foliar spraying of phytanol MI @ 1g/5lit of water is essential at an interval of two months followed by spraying with blitox @ 2gm/lit of water at two moth interval.

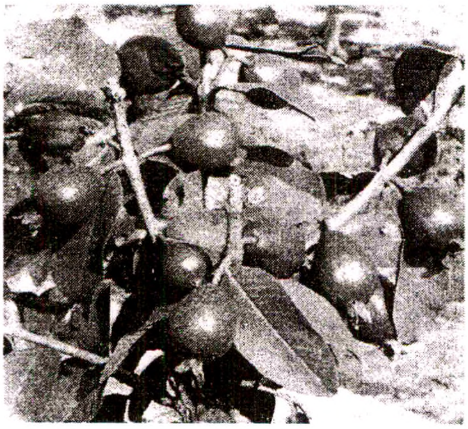
Application of manures and fertilizers : After 3 months of planting, plants were feeding with 10-26-26 fertilizer @ 200 gm + Sand + vermicompost 5kg. In the same year another feeding programme to taken with application of 10-26-26 fertilizer 500gm + vermicompost 5kg + one kg neem cake) after nine month of planting. The fertilizers like 250gmN + 125gm P + 125gm K along with 10kg vermicompost are applied in the field when plants are reaches up to 1-2 year age, but 3-4 years plant to be feeding with 500gmN + 200gm P + 200gm K +10kg vermicompost. Finally, 5 and above aged plants are to be manure 600gmN + 250gm P + 250gm K +10kg vermicompost. The recommended dose of fertilizer should be given just after fruit harvesting. Application of *Azatobacter* 250gm along with 100g N is same as 300g N used. Soil application of boron 12.5g + 45g zinc sulphate/plant and monthly interval of foliar application of ferrous sulphate 4g + manganese sulphate 3g + baric acid 2gm/lit of water is beneficial for fruit quality.

Pruning : Pruning is the important practices for pomegranate cultivation, according to Parvatha *et al* (2000) reported the plant is topped at a height of 60-70cm and side shoots of 4-6 in number well distributed along the main stem are allow to arise, thin shoot(15cm length from the main branch during flowering stage), water soot(off-bearing shoot), suckers(developed from the ground) and diseases infected shoots are to be removed as when required. After harvesting, plants are need to rest and this time plants are treated with Curacron (0.4%) or ethereal (0.3%) or Dormex (1%) for defolation to induce new growth.

Mulching : The base of the plants is to be heap with soil up to 30cm height from ground level against lodging followed by *Glyricidia* leaves mulching (4 sq.ft area).

Watering : Drip irrigation at alternate day with four drippers is an ideal for watering of pomegranate, it has been estimated that 270 lit of water/month/plant is required to full fill the need of plants. It has been estimated that, 40% of water is save through drip irrigation against traditional practice, not only that this method of irrigation to reduce the wilt disease also.

Plant protection : Bacterial blight-control by foliar application of streptomycin @ 1000 ppm, another major problem is wilt and control by drenching with one of the fungicides like copper Sulphate (0.2%), nickel chloride (0.2%), salicylic acid (0.2%), propiconazole 25EC (0.1%) and sulphure 80% WP (0.1%) reported by Jadhav *et al* (2010). Fruit borer is a serious problem in this belt and it is effectively control by foliar spraying of endosulfan 35EC @ 1ml/lit of water during May-June at 15 days interval, at least two spraying will be required.



Harvesting : Before harvesting the plants to be treated with ethrel 500 ppm + Cytozyme 100ml + potassium dihydro orthophosphate 100g/100 lit of water for improving fruit skin colour. After 18 month of planting, fruits are ready for harvesting and 4-5 months is required for harvesting after flowering. Two crops can be taken, not more than in a year (Ambebahar flowering: January-february and fruits are ready to harvest in the month of July-August) and Hasthbahar (flowering: in the month of October and fruits are ready to harvest in the month of March-April). Effective yield can be obtained up to 5-25 years with 20-35 kg/plant and that is 5-7 tones/acre.

Cost of cultivation : To established a one acre orchard for pomegranate, it is estimated that initially Rs. One lakh to be invest. After spending of 5 years, the year wise return to be get Rs. One lakh (approximately) and it should be reached up to two lakh/year.

D. High Density Planting of Guava Cultivation :

Guava is the high nutritive value fruit crop and India is one of the leading county in the world to produce 20 thousands tones of fruits, but this is not sufficient according to the demand in the domestic market, besides the table purpose, there is huge requirement in food industry for value addition in jelly making. It has been estimated that the price value of guava near about Rs.30-40/kg, though it is a poor man fruit. Now it is beyond the purchase power of general people. Area under guava cultivation is increasing day by day, but productivity is going down and recently a technology has been established that high density planting give two and half time more yield as compared to traditional practices. This technology already conceived in Maharastra state and planted near about 105 hectors of land and it can adopted in the guava growing area in West Bengal.

Commercial Varieties : L-49, KG, Hariza and Baraipur Selection are the best varieties for West Bengal situation in all aspect.

Planting : A trench should be made 45cm depth in the month of May and after one month it should be filled with a mixture of well rottened cow dung manure 2 kg +100gm bone meal + 100gm neem cake +100gm SSP/sq.mt in the month of June. The air- layered with good quality of one year aged plants having 2-3 branches are planted in the trench, when rain start and trench to trench and plant to plant distance to be maintain 2 and 1 m respectively. There should be a open 45cm depth another trench between the rows for reducing wilt disease. After planting, foliar spraying of phytanol MI @ 1g/5lit of water to be given for better growth and development at an interval of two months.

Application of manures and fertilizers : After 3 month of planting, plants were feeding with 10-26-26 fertilizer 100gm + vermicompost 5kg. The regular application of nutrients to be practices with 10-26-26 fertilizer 200gm + Vermicompost 5kg + 200g neem cake after each pruning. After pruning the plants were spraying with boric acid (1.5gm/lit. of water), CuSO4 (2gm/lit of water) at monthly interval followed by miraculan (1/2ml/lit of water) for proper growth and development of branches.

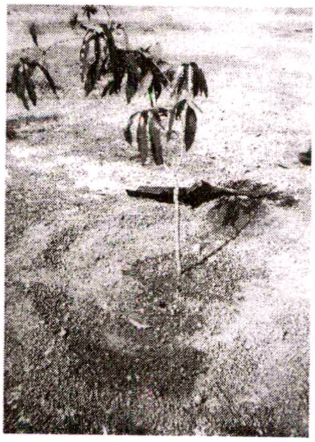
Pruning : Guava plants were produces flowering and fruiting three times in a year and flowers are inducing only in new shoots. So, more number of new shoots is essential for better harvesting. In this context, soft and semi hard wood of the branches should be removed after harvesting of fruits followed by heavy manuring for growth and development of new shoots. After pruning the branches of cut end should be treated with bordex mixture.

Watering : Drip irrigation at alternate day with four drippers is ideal for watering of guava, it has been estimated that 350 liters of water/month/plant is required to full fill the need of plants, which is 45% save against traditional practice, not only that this method of irrigation to reduce the wilt disease.

Plant protection : Wilt is the serious problem of guava cultivation and it can be effectively control by drenching with one of the fungicides like copper sulphate (0.2%), nickel chloride (0.2%), salicylic acid (0.2%), propiconazole 25EC (0.1%) and sulphure 80% WP (0.1%). Fruit borer, it is a serious problem in this belt and control by foliar spraying of endosulfan 35EC @ 1ml/lit of water during May-June at 15 days interval, at least two spraying will be required.

Harvesting : Generally guava produce 20-22 tones fruits/ha under traditional practices, whereas 45-50 tones can be harvest /year (three time harvest with 17.00, 12.00 and 18.00 tones) with above mentioned devices.

E. Mulching with Pitcher Irrigation save the newly planted Grafted Mango and Cashew Nut plant in Red and Laterictic Soil.



Mulching is the important practices in agri-horticultural operation in India. Now different type of mulching materials like straw, jute felt, dry leaves, green leaves, leaf mould, FYM, Cow dung manure, saw dust, polyethylene are used an objectives to soil conservation in the high rain fall area, water as well as moisture conservation in rain fed area and weed management in high moisture content soil area. The mulching materials are very less cost effective and bring the soil productive for promotion and production of horticultural crops. Now, it very efficiently used in plant survivability of mango and cashew nut in the red and lateriotic areas. The unutilized huge wasteland is using as grazing land for the animals in the red lateritic belt and this is not being used for any kind of production. The major problem of this area is mostly hold by the poor farmers or resource-poor small and marginal farmers. The soil is sandy coarse lateritic, content with rich Fe and Al, but deficient in Ca, S, B, K, P and organic matter. The average rainfall of this area is 1200 mm. and 90% of which is received from June to September in rainy season, late on-set, period of long dry spells during rainy season, early cessation of rain are some of the common weather aberrations which result in low productivity and frequent crop failure. The temperature during the winter falls to 16°C to 17°C and rose up to 40°C to 42°C in the summer. This belt has a greater scope of cultivation of cashew nut in up-medium land and mango in medium land, but plant survivability of grafted plants is the major problem in this area during winter and summer. Considering the prevailing situation, 90% plant can be survived in this area by providing black-polythene mulching (400 gauge) with pitcher irrigation by plastic bottle. Here, after rainy season, 4sq.ft around plant foot area to remove soil up to 6 inches depth and placed two number of plastic bottle having capacity to hold one liter of water, the lower side of the bottle make 2-3 holes for leaching of water. The placement of the bottle should be in such a way that up to neck of the bottle to be inside the ground followed by spreading of green grass and then 4 sq.ft (2 × 2ft) black polythene to be placed on the green grass. The polythene should be covered with soil up to 6 inches height to reduce the temperature inside the polythene. Before polythene mulching, the soil is treated with Chloropyriphos (Durshban @ 2ml/lit. of water). Every 15 days interval the bottles are filled with water, while plants can be easily grow well in this situation. According to Singh and Kumar (2003) black polythene mulching is effectively controlled weeds as well as improved the plant growth. Soil compaction reduced by mulching, resulted in more aeration in the soil and due to increase in soil moisture the availability the plant nutrients increased and black polythene mulching responded better in this aspect in comparison with other mulches. Tomar *et al.* (2005) observed that mulching of cashew nut with black polythene gave higher yield (1.5 kg/tree) as compared to non mulche trees(1.4kg/tree) and also reported that in mangoplants mulching with same material that improved growth and yield as compared to paddy husk.

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FIGHTING NEMATODE PROBLEM IN ORNAMENTALS UNDER HI-TECH PRODUCTION SYSTEM

Matiyar Rahaman Khan

Introduction :

Plant parasitic nematode (PPN), the hidden enemy of crops is one of the many groups of harmful organism which depend on plants for their survival. Nematode can cause damage to almost all kinds of crops, however, due to their subterranean habit, microscopic size usually from 0.25 to 3 mm length (~1/100 to 1/8 inch), they are invisible to the naked eye. They penetrate and feed on the root of growing plants, stealing nutrients vital for plant growth and exposing the roots to attack by other soil pathogens. Parasitic nematode reduces crop yields through direct destruction of plant cell and vectoring plant viruses, and indirectly by facilitating fungi and bacteria. It has widely been recognized that PPNs constitute one of the most devastating pests groups and are responsible for insidious disease symptoms in different crops causing huge crop losses. Estimated annual yield losses in the world's major crops due to PPN is about 12.3% and it is about 14% in the developing countries (Sasser and Freckman, 1987) and more recent estimate indicates that this could be more than US $100 billion per year. PPN is responsible for both quantitatively and qualitatively yield losses amounting about Rs. 21068 million every year in India. Beside direct damage, PPNs serve as predisposing agents in development of disease complexes with fungi, bacteria and viruses. In many situations, plant varieties resistant to fungi, bacteria are rendered susceptible when parasitized by nematodes. There is no doubt that nematodes either alone or in combination with other pathogens constitute an important constraint to world food production. Intensive and extensive cultivation of crops particularly in irrigated crop production system has seriously aggravated nematode problems in various crops. The hidden nature of nematode causing damage out of sight of farmers, scientists and non specific disease symptoms in the above ground parts of the crops are perhaps main reasons why so little attention has been given to the hidden pest of crops.

Management of PPNs with the use high doses of DD, EDB, DBCP etc. had been found promising, though did not receive much popularity. Moreover, all the effective chemicals have been withdrawn from world market due to their harmful effects on human being and environmental concerns. Subsequently, efforts have been made to search for newer chemicals among the group of non-fumigants but failed to achieve the effective control as that of fumigants. In fact, nematodes are comparatively hardy animals require high doses of insecticide having nematicidal property. The growers are still dependent on the limited number of insecticides only because of non-availability of true and effective nematicides. With the increasing concern on environment, various alternative pest control methods like cultural, physical, biological control and botanicals are being used to reduce nematode damage of crops. However, judicious use of chemical nematicides could be applied for protection of many high value crops. Integration of various available practices is one of the current approaches for managing pest problems in crops. Cultural practices are known from time immemorial as a multiple pest control strategy. Biopesticides of botanical origin have also been proved as effective alternative of nematicides.

Therefore, current options for nematode management are cultural practices, physical methods, biointensive nematode suppression, botanicals and sensible use of chemical nematicides.

Considering importance of nematode pests in the integrated pest management (IPM) system, some of the low input plant protection technologies viz. summer ploughing, soil solarization, organic manuring, crop rotation, adjusting dates of sowing, growing resistant varieties, irrigation management, optimum fertilization, hot water treatment, clean cultivation, green manuring, inter/mixed cropping, judicious use of pesticides, integration of two or more above mentioned methods (Gaur & Khan, 1995) could be adopted for managing insect pest, diseases including nematodes in the crop production system.

Nature of Nematode Problems :

PPNs can be detrimental to crop growth and development depending on population density and host susceptibility. Generally, they feed on the host tissues with the help of their protrusible stylet causing plants injury and due to feeding and secretion modify the host tissue into specialized nutritive cells as multinucleate giant cell (as root knot nematode), syncytium(as cyst nematodes) or nurse cells(citrus nematode) for ensuring permanent feeding. Some other nematodes induce gall formation on plant's root (as root knot nematode), and seed (as wheat seed gall nematode), distort stem and foliage (as *ufra* nematodes in rice) and discolouration of grains (as white tip nematode). While feeding on plant tissues, develop lesion (as lesion nematode) as a result of cell death and subsequent discolourations. Some are plant parasites on young foliage and flower stalk (foliar nematode predominantly *Aphelenchoides* species). With their sharp stylet, they puncture plant cells for feeding. Infected plants are easily attacked by various pathogens like bacteria, fungi and develop a disease complex/diseases syndrome. The etiology of those diseases caused by the organisms involved is difficult to determine. Several nematodes serve as vector of plant viruses. Thus nematode functions as plant pathogen, predisposing agent and vector of plant viruses. PPNs are known to interfere the activity of beneficial nitrogen fixing *Rhizobium* bacteria in leguminous crops.

PPNs are great concern in ornamental crops as these crops are being commercially cultivated in protected as well open field conditions. Some of them which are relevant to India and West Bengal situation are discussed with their management options.

Importance of Nematodes in Ornamental Crops :

The common feature of growing major ornamental crops is monoculture which provides congenial environment for one or the other nematode species. The nematode population, if unchecked increases an alarmingly high level and may finally wipe out the whole crops. Moreover, nematode at low population level may render the planting material like bulbs of tuberose and gladioli unmarketable. The infected planting materials are the potential source of spread of nematode into newer areas. In USA, losses in ornamental due to nematodes were estimated to the tune of $60 million annually (Hauge, 1972) Worldwide estimates in ornamental crops, the nematodes are responsible for 11.1% losses (Sasser and Freckman, 1987). However, in India, the losses due to nematode alone in ornamental crops are not yet available. The foliar nematodes, *Aphelenchoides* spp, have emerged as important pests of ornamentals in North America during the last decade. Consequent to the ban on the use of potentially toxic pesticides, currently no nematicides registered to manage foliar nematodes on ornamentals (Jagdale and Grewal, 2001).

Unlike other crops, ornamentals harbour a numerous nematode species, some nematodes establish parasitic relationship and on the basis of their intrinsic pathogenic potentials cause huge economic losses (Table 1). Nematodes like *D. dipsaci* were reported to be responsible for completely wiping out of the narcissus industry in Britain (Hauge, 1972). Some nematode species like *Meloidogyne* spp. on gladioli; *Aphelenchoides ritzemabosi, Belonolaimus longicaudatus* and *Trichodorus* sp. on Chrysanthemum in USA, *Xiphinema* sp. on roses in USA and *X. diversicaudatum* in Western Europe (Hauge, 1972), *Aphelenchoides besseyi* on tuberose in India (Chakraborti and Ghosh, 1997, Khan *et al*, 1999, Khan and Pal, 2000; Khan, 2001) are the major nematode pests resulting in considerable growth reduction and yield loss to the extent of 59% (Pathak and Khan, 2009). Root knot nematodes (*Meloidogyne* spp.) are gaining significance in tuberose, gladiolus, balsam, gerbera, etc. from West Bengal.

Table 1. Economically Important Plant Parasitic Nematode associated with Ornamental Crops

Ornamental Crops	Nematode Species
Rose	*Helicotylenchus nannus, Hemicyclophora typical, H. typical, Hoplolaimus galeatus, M. javanica, Pratylenchus penetrans,Pratylenchus pratensis, P. vulnus, Tylenchorhynchus* spp., *Xiphinema basiri, X. diversicaudatum*
Chrysanthemum	*Aphelenchoides ritzemabosi, Apratylenchoiaes homoglans, Helicotylenchus crenatus, Hoplolaimus indicus, Meloidogyne incognita, M. indica, M. javanica, Pratylenchus penetrans, P. coffeae, R. reniformis, Tylenchorhynchus dubius*
Tuberose	*Meloidogyne* spp., *M. incognita, M. javanica, M. arenaria, Rotylenchulus reniformis, Helicotylenchus* sp., *Hoplolaimus* sp., *Tylenchorhynchus* sp., *Criconemoides* sp.
Gladiolus	*M. incognita, Aphelenchoides besseyi, Trichodorus* spp.
Carnation	*M. incognita, M. arenaria, M. javanica, M. hapla, Pratylenchus* spp., *Criconemoides xenoplax, C. curvatum*
Jasmine	*M. incognita, Aphelenchoides besseyi, Radopholus similis, Tylenchulus semipenetrans*
Crossandra	*Pratylenchus delattrei, M. incognita, Longidorus africanus*
China Aster	*Aphelenchoides ritzemabosi*
Zinnia	*Aphelenchoides ritzemabosi*
Salvia	*Aphelenchoides ritzemabosi*
Dahlia	*Aphelenchoides ritzemabosi*
Balsam	*Meloidogyne incognita*
Anthurium	*R. similis, Paratylenchus minutes, Pratylenchus coffeae, Meloidogyne incognita, Helicotylenchus dihystera*
Orchids	*Aphelenchoides ritzemabosi*
Bougainvillea sp.	*Tylenchorhynchus chonai*
Kochia	*Meloidogyne incognita*

Tuberose :

Foliar nematode (Aphelenchoides besseyi)

Foliar nematode, *A. besseyi* has appeared as a serious problem in tuberose in West Bengal. This nematode was first time reported from Hawaii Islands on the leaves of tuberose (Holtzmann, 1968). The occurrence of floral malady caused by *A. besseyi* in tuberose was first time recorded from Ranaghat areas of Nadia district of West Bengal (Chakraborti and Ghosh, 1993). In India, this nematode is widespread in Eastern and Southern states particularly in rice causing 'white tip disease' and estimated to cause yield loss 20 to 30% in rice, though floral disease caused by *A. besseyi* in tuberose was not encountered any other states except West Bengal. Recently, it has got spread to neighbouring state, Orissa either through movement of bulbs or other means. Recent survey results revealed that *A. besseyi* is a major limiting factor for cultivation of tuberose in Ranaghat and Haringhata regions of Nadia, Bangaon of 24-Parganas (South) and some pockets of Howrah and Midnapore districts of West Bengal. The high population of *A. besseyi* was also recorded from fields of Kolaghat-Panskura-II of Midnapore district. The 'single' cultivar of tuberose was found to be the most vulnerable to damage caused by *A. besseyi* as compared to 'double' cultivar. Khan *et al.*, (1999, 2001) investigated for severe infestation of foliar disease in tuberose and proved *A. besseyi* is the primary causal agent for malformed flowers. The population of *A. besseyi* causing white tip disease in rice is the same population infecting tuberose and causing floral disease (Khan, 2001). *A. besseyi* is now recognized as the key nematode pest of tuberose and it is becoming a potential threat for cultivation of tuberose in West Bengal.

Symptoms : The infected flower stalk initially appears rough, stalk become crinkled, stunted and finally distorted and in severe cases flower buds failed to bloom. Brown streaks appear on leaf bracts and petals and subsequently develop rusty brown spots. The severely infected flower stalk becomes rotten and brittle over drying, even get blind. The number of flowers per stalk is also reduced and small crinkled and distorted flowers which are not acceptable in the market. The nematode, *A. besseyi* remains in masses forming 'nematode wool' which could be easily recovered from dark brown spots (Khan & Pal, 2001). The ovary contains large number of nematodes. This nematode is more serious during rainy season generally from July to September and cent percent loss of second year crop occurs particularly in 'calcutta single' cultivar of tuberose. However, in 'calcutta double' cultivar 30% to 40% flower stalk rendered unsaleable and individual flower stalk contains up to 45,000 nematodes (Khan 2004; Khan, 2006b).

The incidence of foliar disease in tuberose (cv. calcutta single) is estimated on a 0-4 scale (Khan, 2004) :

0 = No malady symptoms on flower stalk
1 = Distortions at basal part of flower stalk but exhibit flower bloom
2 = Entire flower stalk exhibit distortions but few flowers bloom at the tip
3 = Entire flower stalk distorted but no flower bloom
4 = Complete sterility of flower stalk or blind head

Bionomics : The nematode is foliar ecto- and endoparasite on tuberose. *A. besseyi* primarily disseminates through infested bulbs, dry plant parts, run-off and irrigation water from one field to other fields. The nematode survives in coiled anhydrobiotic condition (quiescent pre-adult and adult stages) in the scaly leaves outside the bulbs. The nematode can also survive in all stages (eggs, juveniles and adults) on the flower stalk of tuberose. It takes 10-12 days to complete life cycle at 30°C. The nematode can also survive in the dried scaly leaves, stems and flowers more than 25 months; however, they can not survive in soil under field conditions (Khan, 2004). The nematode is a serous problem in areas where rice and tuberose are cultivated in the cropping sequence. The association of two fungi, *Fusarium oxysporum* and *Alternaria alternate* with the floral malady in tuberose (Chakraborti and Ghosh, 1993) was known but they did not play any role in the development of typical foliar disease in tuberose (Khan, 2004).

The peak period of multiplication occurs during March to August at West Bengal conditions but least multiplication occurs during winter months. The temperature and RH influenced the nematode infestation in tuberose. The nematode maintains high population (1084-2768 per flower stalk) of during July-November (temperature 25°C-33°C) and the lowest (87 per stalk) in the month of January (temperature, 10°C -26°C) in tuberose (Khan, 2004).

Management :

Among the varieties of tuberose tested (shringar, calcutta single, calcutta double, hyderabad single, hyderabad double, suvasini, baibhav, prajwal and phule rajani), prajwal and shringar are tolerant to *A. besseyi*. The strategy for managing foliar nematode in tuberose has been evaluated (Khan *et al.* 2002; Khan *et al*, 2005; Khan, 2006a, Pathak and Khan, 2010) and following practices were found effective to reduce nematode infestation in tuberose:

- The planting material (bulbs) should be soaked overnight either in plain water or in 5% neem-seed-kernel-extract (home preparation from locally available neem) for overnight or dipping of bulbs in monocrotophos 36SL at 500ppm for 6 hours.

- After sprouting of the bulb, three to four sprayings with monocrotophos 36 SL at 500ppm at 15 to 20 days interval should be given
- In the second and third year crop, sprayings with monocrotophos 36 SL at 500ppm at 15 to 20 days interval starting from the month of May onward reduce the nematode infestation.
- Clean cultivation of tuberose and any infested parts of plants found in the field should be burnt immediately
- Growing tolerant cultivars Prajwal, Phulerajani and Shringar of tuberose

Root-knot nematodes, Meloidogyne spp. :

Meloidogyne spp. is as an important pest of tuberose. *M. arenaria* and *M. incognita acrita* was known as the most potential and pathogenic species. The root-knot nematode is one of the major factors for 'tuberose decline' in India, (Jayaraman *et al.*, 1975). The nematode affected plants exhibits yellowing, drying up of leaves and retarded growth. The emergence of spike is also suppressed in the severally affected plant. *M. incognita* cause severe reduction to the extent of 65% of top growth of plant at high population level (Sunderababu and Vadivelu, 1988).

Management :

The treatment of nursery bed with carbofuran or phorate at 60g/m^2 is effective (Parvatha Reddy and Rao, 2001) and soil application of aldicarb at 20 mg/plant or carbofuran 3G at 10-20 g/plant is also effective to manage the nematode. Two cultivar of tuberose viz. Shringar was reported as resistant and Suvasini as tolerant to *M. incogita* (Nagesh *et al.*1995).

Use of VAM, oil cakes of neem, pongamia, castor either alone or in combination with *Paecilomyces lilacinus* (egg parasitic fungus) was found effective to manage root knot nematode problems in tuberose (Nagesh *et al.* 1998a).

Gladiolus :

Nematode inflicts damage in roots of gladioli in well-drained light sandy or loamy soil. Parvatha Reddy *et al* (1978) first time reported root knot nematode, *Meloidogyne incognita* infecting gladiolus from Bangalore, India. Besides, stubby root nematode, *Trichodorus* attacks gladioli corms and roots. *M. incognita* is reported to cause heavy damage to this crop in Bangalore and New Delhi, India (Gaur *et al.* 1995). The root knot nematodes are primarily inducing root gall and invade daughter corms and cormels. The nematode can survive inside the tissue of corms and disseminated (Gaur *et al.* 1995). The nematode affected plants appear stunted with yellowing leaves, shorter spikes and flowers. The presence of *Meloidogyne javanica* greatly increased the severity of gladiolus scab caused by *Pseudomonas marginata* as well as the number of scabbed corms (El-Goorani *et al.*, 1974).

Management :

The nematode could be carried through the infected corms and cormels in storage and spread to fields (Magie and Cowperthwaite, 1954). Use of nematode-free planting material appears to be most effective approach to avoid the nematode infestation. The infection of root-knot nematode in planting material could be reduced by dipping infected corms in fensulfothion or nemacur at the rate of 16g/10 litre of water. The soil fumigation and treatment of dormant planting stock in hot-water at 53°C-57.8°C for 30 minutes helps to reduce the nematode problem. Growing antagonistic crop, marigold as inter crop or in rotational sequence reduces soil nematode population in the field. Soil application of carbofuran 3G or phorate 10G at $3g/m^2$ is also effective. The use of *Paecilomyces lilacinus* + *Trichoderma harzianum* + neem cake, and *P. lilacinus* + *T. viride* + neem cake combinations is also effective to manage nematode infection as well as wilt fungi (c.o. *Fusarium oxysporum* f.sp. *gladioli*) in gladiolus (Nagesh *et al.* 1998b).

Gerbera :

Root knot nematode infects gerbera and completes its life cycle. *Meloidogyne arenaria, M. hapla, M. javanica* and *M. acrita* are known to attack roots of gerbera, often forming small galls, but plants may die before galls develop. Nematodes invade the central root cylinder, leading to bark splitting and necrosis accompanied by fungal (*Phytophthora* and *Verticillium* spp.) and bacterial infections (Zunke, 1981). Root knot nematode species (*M. incognita* and *M. javanica*) are the major nematode pest for cultivation of gerbera in West Bengal. The nematode affected plants die out earlier than the healthy one because of faster deterioration of plants due to infection of soil borne wilt-fungi. A synergistic interaction of *M. arenaria* and *Phytophthora cryptogea* was recorded in *Gerbera jamesonii* and the disease intensity increases up to 80% (Schlang and Sikora, 1978; 79).

Management :

The bare dipping of mature root of gerbera plants infested with *Meloidogyne incognita acrita* in ethoprophos at 0.04% for 30 minutes eliminated nematodes (Stokes *et al.* 1973). The infection of *Pratylenchus coffeae* on gerbera, *Gerbera jamesonii* cv. Teracombi caused reduction of number of flowers and root weight (Choi *et al.* 1992).

Carnation :

Among the nematode species known to attack carnation, root knot nematode, *Meloidogyne* spp., root lesion nematode, *Pratylenchus dianthus*, ring nematodes, *Crionemoides xenoplax, C. curvatum* are the major nematodes which causes serious problems either alone or in association with soil borne pathogens. The decline of carnation was reported due to the attack of *Pratylenchus dianthus* and *Tylenchorhynchus dubius* and the ring decline of carnation is characterized by reduced root symptom, stunted top growth and reduced blooming. The root knot nematode is a serous problem of growing carnation in Himachal Pradesh. *Heterodera trifolii* are found frequently in carnation, often simultaneously with *Fusarium oxysporum* f.sp. *dianth* (Arbelaez *et al.* 1999).

Management :

Soil amendments with neemcake at 1kg/m^2 either alone or in combination (half dose ~ 0.5kg/m^2) with *Trichoderma viride* at 100g/m^2 is effective to control root knot nematode infecting carnation.

Approaches of Nematode Management for Ornamental Crops:

The ornamentals are considered a high value cash crop when grown commercially, or are grown for their aesthetic grandeur on small scale. In both the cases the cost of pest management is not an important limiting factor. The chemical control, if available, can often be employed. However, due to scarcity of nematicide, alternative approaches of physical and cultural methods are under use to keep the nematode population below the damaging level.

i. Ornamental Plant Selection and Cultural Practices

The utilization of tolerant ornamentals in planning landscapes should avoid many of the problems encountered when susceptible ornamentals are planted on nematode infested field develop decline symptoms. Cultural practices such as cover crop/mulch, crop rotation or intercropping with antagonistic/enemy crops like marigold, mustard and watering during droughts may extend the life of the planting. However, growing tolerant or resistant species give long term control of nematodes.

ii. Summer Ploughing

Summer ploughing has been widely recognized as an effective approach of reducing the nematode population. In areas with intense hot summer 2-3 deep plough at 10-15 days interval during summer months before planting of ornamental crop could be useful for reduction of nematode population in soil.

iii. Soil Solarization

Under this practice a transparent colourless this polythene sheet is covered on the moist infested field or pot soil for 4-5 weeks which results in retaining moisture and more heat in upper soil layers than uncovered field. The solarization is also very effective in reducing not only nematodes but also weeds, fungi and bacteria.

The raising of seedling in solarised soil in polythene bags simply by exposing the packets on concrete floor on open sun for 2-3 weeks before sowing the seeds. This practice has multifaceted advantage because it could also suppress weeds and soil inhabiting pathogens in the soil. This practice is highly effective in reducing the root-knot and reniform nematodes.

iv. Hot-Water Treatment

Physiotherapy, involving hot water treatment of infested plant material in dormant condition like seed, tuber, bulbs, cutting or stools; may be effective in reducing the spread of nematode to newer areas. The hot-water treatment (HWT) of *Chrysanthemum* stools at 46.1°C for 5 minutes could control *Aphelenchoides ritzemabosi*. But is difficult to maintain such accuracy in practice and any over heating is likely to affect the viability of material being treated. A practical feasible modification of the method for Chrysanthemum involves heating the water to 48°C and then emerging sufficient shoots to bring down the temperature to 46.1°C during 5½ minutes.

The HWT of gladiolus corms at 57.8°C for 30 min. (Magie *et al.*, 1966) has been recommended to get nematode free planting stocks. In case of carnations which may be sensitive to bromine base fumigants, the steam sterilization of soil has been found useful in reduction of nematode population. In case of ornamental crops some important advances have been made in chemical by dip treatment and spot application of nematicides.

v. Chemical Treatment

The bare root dipping with aldicarb, carbofuran, fensuphothion, fenamiphos or phorate in 0.05 to 0.1% solution for 8 hours protected crossandra seedlings against the *Pratylenchus delattrei* up to 30 days after transplanting (Vadivelu and Muthikrishnan, 1979). The dipping of gladioli bulbs in thionazin or fensulphothion at 0.5 g a.i. per litre is quite effective against the nematode.

A. ritzemabosi and chrysanthemum can be controlled by sterilizing the compost by steam or with Methyl bromide. Foliar drench application of thionazin may help in treating the loci of infection. Pre-plant soil fumigation with methyl Bromide, Metam sodium or application of nematicides like aldicarb, carbofuran, thionazin, nemafos may prove helpful in reducing nematode attack. The foliar nematode, *A. ritzemabosi* infecting chrysanthemum and zinnia was effectively controlled by spraying methyl parathion, chlorpyriphos and quinalphos at 0.05% (Gill and Walia, 1980; Gill, 1981).

vi. Biological Control of Nematodes on Ornamentals

A useful control strategy for the future may be development of delivery systems that utilize antagonists of nematodes pests. Research with bacteria and fungi antagonistic to various nematodes has shown promise on some annuals. However, the development and utilization of biological control system for ornamentals in general, a strategy is largely unexplored at present. The egg parasitic fungus, *Paecilomyces lilacinus* were found to very effective to control root knot nematode species infecting crossandra and tuberose (Khan and Parvatha Reddy, 1992). The split application of *P. lilacinus* at 50g rice grain (spore load 18×10^8/g) in combination with oil cakes at 2kg/m^2 (at planting and 45 days later) significantly reduced root-gall index, root and soil populations of *M. incognita* in tuberose (Nagesh *et al.* 1998a).

vii. Integrated Nematode Management in Ornamental Crops

A combination of tactics may be useful minimizing nematode problems on woody ornamentals. This strategy involves (i) identification of nay parasitic nematodes in the planted planting site; (ii) submission of soil samples to a nematode advisory service can provide the grower with this information; (iii) selection of most tolerant ornamentals should be an important consideration also; (iv) Pre-plant soil fumigation should be used where susceptible ornamentals must be grown; (v) use of transplant stock free from parasitic nematodes cannot be overemphasized; (vi) good management practices including fertilizing, mulching and watering may limit damage done by nematodes (Benson and Barker, 1985). The root knot nematodes infecting crossandra, tuberose was rationally managed by integration of fungal bioagents, *Trichoderma harzianum* or *Pochonia* (=*Verticillium*) *chlamydosporia, Glomus mossae or G. fasciculatum* (VAM fungi) with aldicarb or neem cake (Khan and Parvatha Reddy, 1992). In the future, use of biocontrol agents and new nematicides hopefully will provide even more effective control of nematodes on woody ornamentals.

Conclusion :

PPNs are one of the major constraints for the production of flowering ornamental crops. Currently, nematode problems are gaining greater attention to the commercial flower growers particularly for production of quality flowers in protected system. The information on nematode problem in different growing conditions (open as well as protected) is still not enough as it is found in other countries like USA, Europe. The ornamental crops are grown with relatively low acreage and the field problems have not been thoroughly investigated for the association of parasitic nematodes along with their impact on crop yield. Further, a few workers have so far taken interest to work out the nematode problems on the crops are probably the reason for which the nematode pest has received less attention. With the increase of total cropped area under ornamental crops, the available information compiled in this review indicates the magnitude of the problems as well as the possibilities of control strategies. In the protective cultivation system, PPNs has become a major threat for raising flowers as the conditions inside the polyhouse is much more conducive than that of open fields. There is an immense scope of promoting biocontrol agents which would provide more effective control of PPNs on ornamental plants. Adequate efforts should be directed towards studies on the interaction of nematodes with other pathogens leading to disease complex. Intensive and extensive survey of nematode problems along with generation of information on prevalence, severity of diseases and identification of hot spots should be undertaken on ornamental crops.

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Phalaenopsis

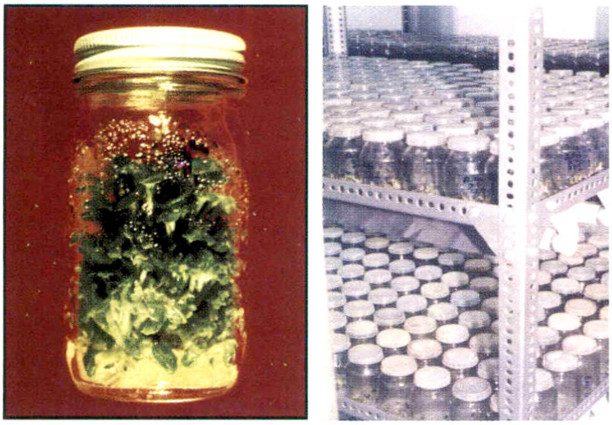
Thunia alba

Oncidium Sphacelatum

Paphiopedilum insigne

Renanthera imschootiana

Vanda teres



Final stage of micropropagation

Anthurium

Final stage of micropropagation

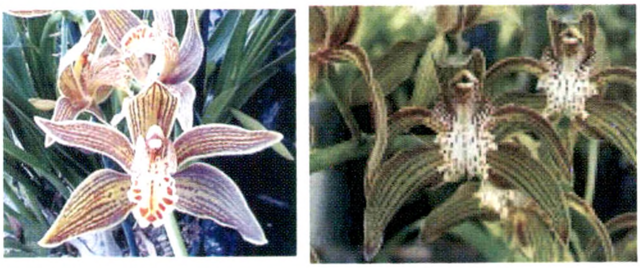
Plantation of Orchids in Green House

Catteleya hybrid

Rose

Flower in shade net house

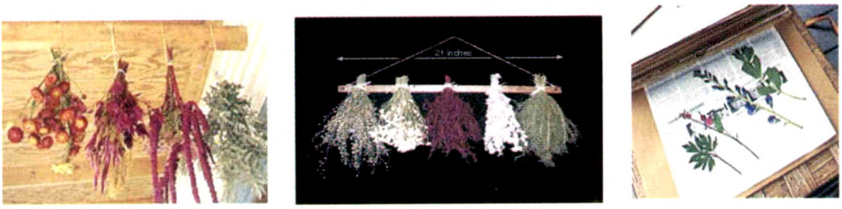
C. giganteumC. tracyanum



Gerbera cultivation

Dendrobium spp.

Nursery management by farmer



Air drying of flowers

Oil Extraction Unit

Plantation by the farmers

Anthurium

Steam Distillation Unit

Poly Shade House

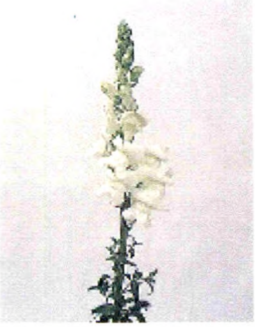
Gerbera

Dendrobium spp.

Chrysanthemum

Flower and Orchid Show

Gladiolus


Snapdragon

Rose

Tube Rose